SCIENCE

AN ILLUSTRATED JOURNAL

PUBLISHED WEEKLY

VOLUME IV

JULY—DECEMBER 1884

CAMBRIDGE MASS.
THE SCIENCE COMPANY
1884

Franklin Press:
RAND, AVERY, AND COMPANY,
BOSTON.

CONTENTS OF VOLUME IV.

SPECIAL ARTICLES.

BOOK REVIEWS.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

[Subsequent proceedings of some of the above societies are given in the advertising pages, Oct. 31 and later.]

LIST OF ILLUSTRATIONS.

SCIENCE.

AN ILLUSTRATED JOURNAL PUBLISHED WEEKLY.

Vérité sans peur.

CAMBRIDGE, MASS.: THE SCIENCE COMPANY.

FRIDAY, JULY 4, 1884.

COMMENT AND CRITICISM.

THE 'sundry civil bill,' which is still under discussion by congress, provides $501,470 for the coast-survey; $244,500 for the fish-commission; $500,000 for the participation by the government departments in the industrial exposition at New Orleans, of which sum one-fifth is given to the Smithsonian institution, including the national museum and the fish-commission; $40,000 for the protection and improvement of the Yellowstone national park; $467,700 for the geological survey; $10,000 for the census of 1880, providing for its close in November next; $149,500 for the national museum; $55,000 for the Smithsonian institution (construction); and $868,038.60 for the signal-service.

It also disposes, for the time, of the question raised concerning the coast-survey, by providing for a joint commission of three senators and three representatives, to "consider the present organizations of the signal-service, geological survey, coast and geodetic survey, and the hydrographic office of the navy department, with the view to secure greater efficiency and economy of administration of the public service in said bureaus," and to report next December. It further appropriates seven hundred dollars for a commission of scientific men, to be appointed by the president, "to inquire into the organization, work, expenses, and reconstruction of the naval observatory, and to report to congress the best system for its future management."

We shall look with deep interest and concern for the reports of these commissions. On the one hand, we are to have a commission of men of affairs, called to consider the mutual standing of several different government bureaus, whose work is more or less inter-related; on the other, a scientific commission, dealing with a purely scientific bureau under naval control, but the vitality and usefulness of which has come, with rare exceptions, from men drawn from the ranks of civil life. Let us hope for good appointments, that these often-recurring and unseemly antagonisms between different departments may be put to rest by excellent reports and wise adjustments. To the question of the relations of the army and navy to science, we may again recur. We may here only regret that it was not arranged that the scientific commission should be taken from names recommended to the president by the National academy.

With this exception, we have no fault to find with another provision of the bill, by which, as we hoped last week would be the case, the appointment of two additional members to the meridian conference is provided for, and an appropriation of two thousand dollars made for the expenses of the commission; nor with a similar provision for a national conference of electricians, in connection with the international electrical exhibition at Philadelphia, for which a meagre five thousand dollars is appropriated, and a scientific commission authorized. The more closely the government can identify the National academy with its scientific undertakings and appointments, the more confident we shall feel that neither science nor our country will be belittled.

THE use of the comma as an instrument for assisting or impeding a reader's comprehen-

sion of an author's meaning is neither a very important nor a very scientific subject of discussion. But many English writers of scientific text-books try one's patience so sorely and so wantonly on this point, that it seems proper something should be said about it. The evil to which we refer usually takes the shape of the insertion of superfluous commas, which in the least obnoxious cases are annoying, and in many cases seriously interfere with the sense. These violations of the literary code of minor morals are so abundant in any work which is seriously subject to them at all, that it is not necessary to go outside the book which happens to be before us at the moment for as long a list of examples as might be desired. The following sentence contains three unpardonable commas, the fourth alone being rightly used: "Thus we shall suppose that the external cause of the cooling determines always the state of the very thin envelope, in such a manner that the value of $\frac{dv}{dx}$ which results from this state, is proportional to the value of v, corresponding to $x = X$, and that the constant ratio of the two quantities is $-\frac{h}{K}$." And before we have finished a page, we come upon this: "It consists in finding the value of v, by means of the general condition, and the two special conditions to which it is subject." Here the insertion of the first comma seems to us bad enough, but this may possibly be regarded as a matter of taste; that of the second is an inexcusable error.

THE September meeting of the mechanical section (D) of the American association for the advancement of science, at Philadelphia, promises well. It is under the leadership of a chairman whose name will go far to insure success; and Professor Thurston's opening address is confidently expected to be a paper of much interest. The circular of invitation, issued by the committee, has been sent to a large number of engineers, representing the most of the American societies; and it has also been laid before them officially through their secretaries, besides being published in a number of prominent technical journals. The work is now going forward of interesting the foreign engineering public directly, and through their societies and journals; and it is believed that a large foreign attendance may be expected. The programme is also being made up, and contains the announcement of several important papers.

AFTER an existence of eight years, the New-York state survey is brought to a close by the will of one man. Like nearly all scientific work done in this country under state patronage, the life of the survey hung by the thread of an annual appropriation. The usual appropriation of $15,800 was made by the legislature; but the item was vetoed by the governor, who thinks, that, "after an expenditure of a sum considerably in excess of a hundred thousand dollars, very little seems to have been done of practical benefit to the people," and who says that he is "not able to appreciate the importance of the elaborate, slow, and expensive survey of the state which this appropriation is intended to continue."

As Gov. Cleveland is commonly reported to give his reasons for official action with perfect frankness, it is evident that this unfortunate close of the survey is due to his ignorance of the value and of the cost of geodetic work. Had he urged that the work was one which should be undertaken by the general government rather than by the state, he would have found many to agree with him, and, at most, the question would have been one of policy; but, when he declares that he is "of the opinion that a sufficiently correct and exact location of boundary-lines and monuments to answer every useful purpose could be conducted . . . at a comparatively small expense," it is plain that his 'opinion' on such a topic is not of weight. Even on economic grounds, it would not be difficult to show that the exact location of bases for local surveys would, in time, save its cost in diminished boundary litigation.

COMMENCEMENT at Harvard last year was enlivened by the vigorous speech of Charles Francis Adams, initiating what may almost be called a national discussion of the Greek question. This year the subject of 'academic degrees' is brought into prominence by a paper, published in the July *Century*, from the pen of Dr. Woolsey. It will not surprise us if a discussion of this subject, begun by one who has held with honor the post of president of Yale college, and is still a member of the degree-giving board, should run for the next twelve months, and draw out opinions as diverse as those lately printed on the comparative value of classical and scientific studies. Most of Dr. Woolsey's article is historical, with incidental references to his own opinions. Toward the close, however, he makes some suggestions with respect to the bestowal of honorary degrees which are worth consideration. He is heartily opposed to the random methods now in vogue of complimenting men who are accidentally brought forward. He does not object to the guarded admission of meritorious students to the lower academic degrees *causâ honoris*, when they have been prevented by illness or poverty from attaining their diplomas in a regular way; and in cases of rare and distinguished merit he would admit to the same honors "discoverers of important principles in science, who had had, perhaps, no public education whatever."

But in respect to what are now bestowed as honorary titles (the degrees of LL.D. and D.D.), he would allow any graduate to prepare, by the study of years, for the highest degree within his reach, whether he resides within the college or not. The proficiency of each candidate should be tested by rigid examinations. Thus a student of law or theology might first take a baccalaureate degree in either of these faculties, — say, four years after taking his B.A. degree, — and eight years still later he might offer himself as a candidate for the degree of doctor of laws or theology. As a protection against the confounding of titles honorably won with those bestowed by careless or feeble institutions, Dr. Woolsey suggests that the indication of a degree shall be followed by the name of the place where it was won. We imagine that it will amuse some readers, and amaze some others, when they read the melancholy statement, made by one who for nearly forty years has been annually creating honorary doctors, that "these honorary degrees are bestowed on no evidence of thorough learning in theology or in law, and thus are in no way certificates of deserving the honors, saving, that, for some reason or other, the corporation of a college regards the person thus honored as a man worthy of notice beyond most of his fellows."

ABOUT two months ago we urged the Massachusetts legislature to be slow in rejecting the offer of the U. S. geological survey to prepare at divided cost a topographical map of the state. We are glad to state that the committee on expenditures, in whose hands the matter was placed, reported favorably; both houses passed the resolve submitted; and the governor has now made the excellent choice, as commissioners, of Pres. Francis A. Walker of the Massachusetts institute of technology, Mr. Henry L. Whiting of Tisbury, and Prof. N. S. Shaler of Harvard college. The resolve appropriates forty thousand dollars, to be extended over at least three years. The names of the commissioners are a guaranty that the interests of the state will be well administered, and that the suggestions made in our columns will not be lost sight of.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

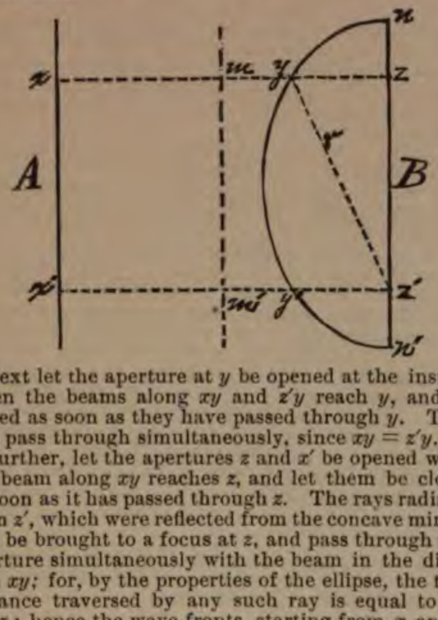
Radiant heat.

IT is much to be regretted that a mathematical physicist of the standing of Mr. Fitzgerald should, in his letter published in your issue of May 16, confine himself to *ex cathedra* deliverances upon the question at issue between us, instead of attempting some direct demonstration upon the points involved, as I had suggested would be desirable. Had he done so, he would not, I am sure, have fallen into the curious mistakes which he emphasizes so strongly. In default of the desired investigation of the question by Mr. Fitzgerald, I hope that the following reasoning

may be of use in arriving at correct conclusions regarding this matter.

Let z and z' be taken as the foci of a semi-ellipse, $nyy'n'$, whose major axis is nn'; and let the eccentricity be so small that zy is greater than $\frac{1}{4}nn'$. Make $xz = nn' = 2xm$. Let a concave reflecting surface be supposed to be generated by revolving the semi-ellipse through angles of $+\frac{1}{2}\pi$ and $-\frac{1}{2}\pi$ about nn'; and let nn' represent a screen in which there are equal small circular apertures at z and z'; let there be also equal apertures at x and x'; and, in addition, let there be apertures at y and y' no larger than will permit the passage of cylindrical beams from the apertures at z and z' respectively.

At first let the apertures x and z' alone be open, and remain so until the spherical front of the wave-surface radiating from x has reached m, and a second wave-front of equal radius, $z'r$, has issued from z'. A part of this latter wave has, at the conclusion of this interval, been reflected from the concave mirror towards the focus z. Let the apertures at x and z' be then closed.



Next let the aperture at y be opened at the instant when the beams along xy and $z'y$ reach y, and be closed as soon as they have passed through y. They will pass through simultaneously, since $xy = z'y$.

Further, let the apertures z and x' be opened when the beam along xy reaches z, and let them be closed as soon as it has passed through z. The rays radiated from z', which were reflected from the concave mirror, will be brought to a focus at z, and pass through that aperture simultaneously with the beam in the direction xy; for, by the properties of the ellipse, the total distance traversed by any such ray is equal to $nn' = xz$: hence the wave-fronts, starting from x and z' at the same instant, will reach z simultaneously.

We have now to consider what occurs at each of the apertures y and z during the interval while they are open.

While y is open, a beam from x, of length xm, passes through it toward B, and a beam from z', of equal cross-section and length, passes through it away from B. These beams are of equal cross-section, because the tangent at y makes equal angles with the focal radii zy and $z'y$. But these beams are not of equal intensity in case A and B are of equal temperature, because any plane aperture, such as that at z', does not radiate equally in all directions. The intensity of the radiation diminishes, according to the well-known law, as the cosine of the angle between the direction of the ray and the normal; i.e., the intensity is less in the ratio of cos $yz'y'$ to unity: hence less heat has escaped at y than has passed through y toward B in the ratio just mentioned.

Now as to the quantities of heat passing through the aperture z. Let us for definiteness take the body B to be common air, enclosed in a capacious vessel whose interior walls are perfectly black. Such being the case, whatever be the intensity of the ray received through z in any given direction, the intensity of the ray simultaneously emitted through z will depend only upon the previous temperature of B, or, at most, only infinitesimally upon the intensity of the ray received. Such being the fact, the beam emitted from z in the direction of y' has the same intensity as that previously emitted from z' towards y. But the beam which is received at z by reflection from y' has a very different intensity from this, for it is the beam which was originally radiated from z' towards y'.

When, therefore, Mr. Fitzgerald says, that, "if heat can go into B in the direction $y'z$, there would be an escape of heat from B in the direction zy' as well as in the direction zy, and so, to the two quantities of heat coming into B, there would escape two equal quantities," I feel that either he has made a mistake, or he presumes upon the ignorance of the reader; and, to use his own inimitable emphasis, I may say that I am sure no American or other scientific man agrees with him; and I think I am justified in adding that no Irishman will agree with him either, including his own better self. To make this point still more evident, we have only to consider what occurs when the concave semi-ellipsoidal reflector without apertures at y and y' is used to transmit radiations alternately between z and z'. First let z be opened during an interval such that rays of a length $\frac{1}{4}nn'$ are emitted; then let both z and z' be closed for an equal interval; next let z' be opened for an equal interval. During this third interval, equal quantities of heat pass through z', towards and away from B; but is Mr. Fitzgerald now ready to re-affirm his untenable proposition that the quantities of heat received and lost in any arbitrary direction are equal? Whether he is willing to do so or not, these quantities are not in general equal, his hasty affirmation of their equality to the contrary notwithstanding.

In close connection with this, it is pertinent to inquire once more what difference there is between the equal quantities of energy which B has simultaneously emitted from and received through z'. The kind of energy we call heat exists in two forms, — radiant and non-radiant; the latter is often regarded as identical with molecular agitation. Radiant heat may be totally reflected regularly, as light is by a perfect reflector; it may be totally reflected irregularly, as light is at a white surface; it may be wholly absorbed, and the energy conducted or radiated away with a different wave-length, as light is at a black surface; it may be wholly transmitted, as light is by a transparent substance; or there may be any combination of these. It is sufficient for our purpose to suppose that the constitution of the body B is such that regular reflection does not occur at its surface, and that the absorption of the rays entering it takes place in its interior, as in a partially or completely transparent substance enclosed in a black vessel. Now, when the rays have been absorbed, as they must be under such circumstances before they can be radiated away from B, their energy exists in the non-radiant form. I have stated in my previous letter, that, "after the energy reaches B, the path by which it has arrived is of no consequence," and that the direction which the rays may have had in coming to B is immaterial to the question under discussion. I stand ready to re-affirm this proposition, and now do so. Mr. Fitzgerald evidently regards this statement as so unscientific as to merit no reply what-

ever, and as such a self-evident piece of stupidity as to render further discussion useless.

Mr. Fitzgerald further says that Professor Wood has pointed out my mistakes. Is he willing to say what mistakes? I am convinced that Mr. Fitzgerald has never read any criticism by Professor Wood which he is willing to indorse; but, since he has himself made reference to these criticisms, I now ask Mr. Fitzgerald to state which of Professor Wood's positions against me he regards as sound. I do not believe he can find one.

Mr. Fitzgerald is unable to find any excuse for me when I introduce the idea of a pencil of rays of infinitesimal angle, unless it be that I have overlooked the fact that the energy of such a pencil is infinitesimal. I beg leave to say that the excuse and the assumption are both entirely gratuitous on his part, and not in accordance with the facts. In the algebraic investigation made in the original paper, as well as in that given above, the angle is not assumed to be infinitesimal, or even small. The sole excuse, and the real one, was that it was a form of argument which it seemed to me would put in a clear light the truth which I had otherwise established, that such a process as had been proposed would heat B at the expense of A.

In conclusion I may be permitted to say, that when Mr. Fitzgerald attempts to treat the controversy which he has himself inaugurated as not worth his consideration, and gives notice that he therefore thinks it not worth while to continue it, he must know that he lays himself open to the suspicion that poverty of arguments, and not disinclination to controversy, leads him to this decision. If Mr. Fitzgerald regards it as compatible with his dignity to beat a retreat on any such pretext, I, for one, cannot agree with him. H. T. EDDY.

Cincinnati, June 10.

Temperature of the spheroidal state.

In some experiments made to determine this point, to avoid radiation, the temperature was measured by a thermo-electric couple, as in Mr. Hesehus's studies. The element used was composed of german-silver and iron, No. 22 wire. The wires were hard soldered together, and then bent into a loop, and inserted in a glass tube filled with plaster-of-Paris. The tube was about twelve centimetres long and five millimetres bore; and the polished loop projected about eight millimetres, with a width of four millimetres. This element was connected directly with a reflecting galvanometer with twenty-five ohms in circuit. The spheroids were formed in a spoon heated over a spirit-lamp, and no special precautions were taken to secure equal temperatures. The loop was plunged in the spheroid, and deflection noted. Ten readings were thus taken with very small variations, and then the loop was placed in a beaker of water almost in contact with the bulbs of two thermometers. The water was then heated till the deflection was the same as that given by the spheroid, and the thermometers were read at this point both while heating and cooling. The variations of temperature were less than 1°; and this part of the experiment was repeated several times. The whole experiment was repeated a number of times on different days, with results all within 1°.

The temperature thus found was, for water, 90°, and for alcohol, 69°.

The size of the spheroid had no effect on the temperature, as the deflection remained constant as long as there was enough liquid to protect the loop from radiation. In the case of alcohol, the globule could be surrounded with vapor-flames until greatly reduced in size, without visibly increasing the deflection. Ether was experimented on; but the temperature proved to be so low, barely above that of the room, that no satisfactory results could be obtained.

The series of experiments hints at a lower and less variable temperature than has usually been assigned to the spheroidal state. LOUIS BELL.

Dartmouth college, June 9.

The inventor of the vertical camera in photography.

In *Science*, No. 70, Mr. G. Brown Goode says, concerning the invention of the vertical camera, "As a matter of fact, the vertical camera now used for photographing natural-history specimens, etc., is the outcome of a suggestion made in December, 1869, by Professor Baird."

As this letter is written to put on record the history of the invention of the vertical camera, it is necessary, in justice to myself and other inventors of a vertical camera, to state that the notes concerning the history of the invention were omitted from my original article (*Science*, No. 62) at the suggestion of the editor. The facts concerning the invention and use of the vertical camera known to me at present are as follows:—

In 1863 J. Gerlach published 'Die photographie als hilfsmittel zu mikroskopischer forschung,' in which was figured and described a vertical camera. In 1866 Montessier, in 'La photographie appliquée aux recherches micrographique,' described and figured a very much improved vertical camera. Both of these are figured and described in Frey, 'The microscope and microscopical technology' (New York, 1872). In 1872 John C. Moss invented a swinging vertical camera, which was described and figured in the U. S. patent-office report, October, 1877, p. 961, plate page 279. This camera was also figured in the *Scientific American* (1877) and in *Leisure hours* (1879). In 1877 also appeared a description and figure of a vertical camera by Schaefer, in 'The microscope and histology,' p. 295. The above, together with the letter of Mr. Goode, the note concerning Dr. Dannadieu's camera, and the papers by myself, constitute, so far as I know, all the published notices of a vertical camera.

By the courtesy of the gentlemen named below, I am enabled to make important additions to the history of this subject. John C. Moss, president of the Moss engraving company, in a private letter, says, "I remember having used a camera in a vertical position in 1858 to copy daguerrotypes and tintypes. . . . I also used the same arrangement to photograph some shells and other small objects." Dr. Deecke says, "I have used the camera in a vertical position since 1873. The simple alterations on the camera were devised by myself, and executed in the shops of the asylum." Prof. E. Ramsey Wright, of Toronto university, also uses a vertical camera; but the date of its invention by him is not known to me. To briefly summarize: the first figure and description of a vertical camera known to me were those of Gerlach, in 1863; while the first to use the vertical camera was John C. Moss, in 1858. Every person using this instrument, so far as appears at present, was *an* originator, but John C. Moss, seems to have been *the* originator, of the idea of a vertical camera.

SIMON H. GAGE.

Ithaca, June 21.

CHARLES ADOLPH WURTZ.

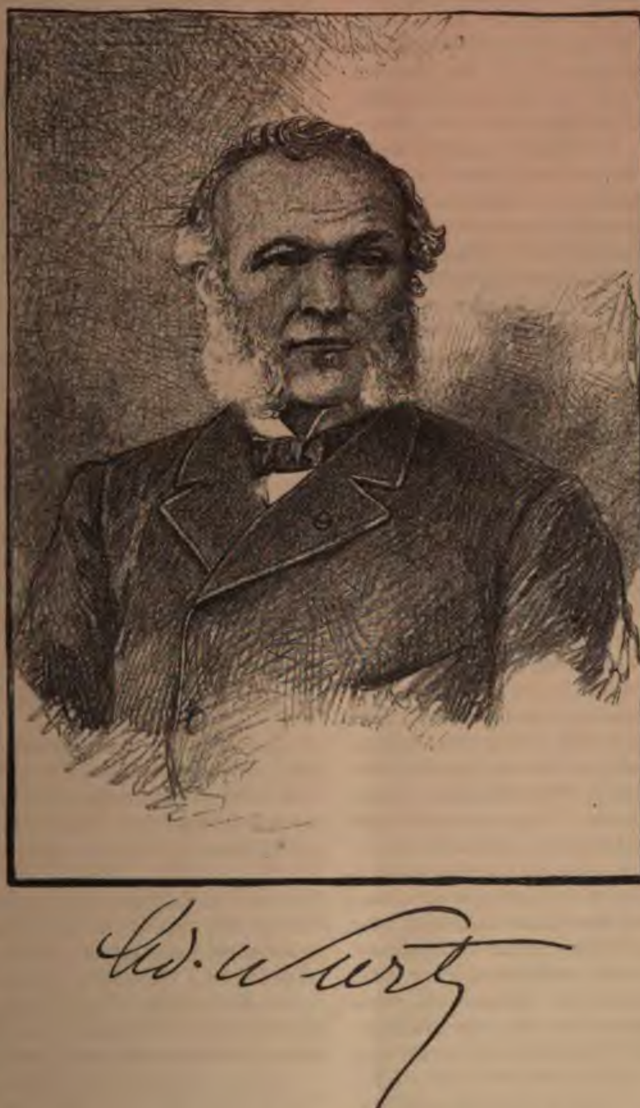
The subject of this sketch, Charles Adolph Wurtz, who died on the 12th of May at Paris, was the chief representative in France of what is generally known as modern chemistry. He was born November 26, 1817, at Strassburg. Here he began his studies, and received the degree of doctor of medicine. Before his graduation in medicine, he was made assistant in the chemical department in the medical faculty; in 1845 he became assistant in Paris; in 1846 he was made chemical director of the School of art and manufactures; in 1851 he became professor in the Agronomic institution of Versailles; and in 1854, after the death of Orfila, he was elected professor of medical chemistry, taking upon himself the duties connected with the chair of pure chemistry, up to that time held by Dumas, and that of toxicology. In 1866 he was made dean of the medical faculty,—a position which he held until 1875, when he became professor of organic chemistry in the faculty of sciences.

Wurtz's contributions to chemistry are numerous and important. He is fairly entitled to be counted among those who have originated and developed the views which are now held by the majority of chemists. The two hypotheses which at the present day form the basis of speculation concerning chemical phenomena, are, 1°, the hypothesis of Avogadro, according to which equal volumes of all gases contain the same number of molecules; and, 2°, the valence hypothesis, according to which the elementary atoms differ among each other as regards the number of atoms of other elements which they can hold in combination. Thus we have the compounds represented by the formulas, HCl, H_2O, and H_3N, in which the atoms of chlorine, oxygen, and nitrogen are represented in combination with one, two, and three atoms of hydrogen respectively. Before these differences among the elements were recognized, the existence of various types of compounds was observed. In a vague sort of way, compounds were referred to this or that type: gradually, however, the idea of types became more definite, and then, undoubtedly, exerted a great influence on the development of chemistry; leading directly, as it did, to the conception of valence. The first important investigation of Wurtz had much to do with giving definiteness to the conception of types. In the paper containing the results of the investigation, he described certain compounds, which he regarded as ammonia, in which one of the parts of hydrogen was replaced by complex groups containing carbon and hydrogen; as, CH_3 (methyl) and C_2H_5 (ethyl). Representing ammonia as $N\left\{\begin{matrix}H\\H\\H\end{matrix}\right.$, the new substances can be represented thus, $N\left\{\begin{matrix}CH_3\\H\\H\end{matrix}\right.$, $N\left\{\begin{matrix}C_2H_5\\H\\H\end{matrix}\right.$, etc. It became clear that substances can be made which bear a very simple relation to ammonia; and a good experimental basis was furnished for referring these compounds to the ammonia type. In regard to this discovery, Kekulé, the distinguished German chemist, says, "The discovery of the bases corresponding to ammonia is indisputably the corner-stone of our present views."

It is an extremely interesting fact, that Liebig predicted the discovery ten years before it was made, in developing his views regarding the nature of the nitrogenous bases, the alkaloids; but the view that these bodies can be referred directly to ammonia in the sense in which Wurtz regarded them was not generally accepted by chemists until shortly after his discovery.

Another important investigation of Wurtz is that which led to the discovery of the so-called diatomic alcohols, the chief of which is glycol. Ordinary alcohol may be referred to the water type in the same way that Wurtz's bases are referred to the ammonia type; i.e., it may be regarded as water, $O\left\{\begin{matrix}H\\H\end{matrix}\right.$, in which one of the hydrogen atoms is replaced by the complex group, ethyl, C_2H_5. According to this view, which is founded upon experimental evidence, alcohol is represented by the formula, $O\left\{\begin{matrix}C_2H_5\\H\end{matrix}\right.$. In 1854 Berthelot's memoir on the fats and glycerine appeared. In this it was shown that glycerine acts in general like an alcohol, but that acids unite with it in three proportions. Wurtz suggested that just as ordinary alcohol may be regarded as derived from water as above indicated, glycerine may be regarded as derived from water as represented in the formula $O_3\left\{\begin{matrix}C_3H_5\\H_3\end{matrix}\right.$. In other words, ordinary alcohol is derived from water by the substitution of one group, C_2H_5, for one hydrogen atom in one molecule of water, $O\left\{\begin{matrix}H\\H\end{matrix}\right.$; whereas glycerine is derived from water by the substitution of one group, C_3H_5, for three atoms of hydrogen in three molecules of water, $O_3\left\{\begin{matrix}H_3\\H_3\end{matrix}\right.$. This led Wurtz to inquire whether,

in a similar way, there might not be alcohols derived from two molecules of water, $O_2\left\{\begin{matrix}H_2\\H_2\end{matrix}\right.$, by substituting some group for two hydrogen atoms. He soon discovered the first member of this group of bodies, viz., glycol, which he showed to be a compound intermediate between ordinary alcohol and glycerine. He represented it by the formula, $O_2\left\{\begin{matrix}C_2H_4\\H_2\end{matrix}\right.$. Probably the most important result of this discovery was the fact that the attention of chemists was directed to the differences between the radicals C_2H_5 in ordinary alcohol, C_2H_4 in glycol, and C_3H_5 in glycerine. In the first the radical takes the place of one atom of hydrogen, in the second one radical replaces two atoms of hydrogen, and in the third the radical replaces three atoms of hydrogen. Here, then, in the polyatomic radicals, we have the beginning of the conception of valence. Just as radicals exist which can replace one, two, or three hydrogen atoms, so similar differences exist between the elements. Regarding the discovery of glycol, Ladenburg, in his 'Entwickelungsgeschichte der chemie,' says, "Seldom has the discovery of a single body exerted such an influence on the development of chemistry, seldom has a single compound given rise to such a series of beautiful and useful investigations, as glycol."



The ideas suggested by the investigations on the substituted ammonias and the polyatomic radicals were followed up by Wurtz and others, and the result is the chemistry of to-day. Wurtz has been an active participator in all important discussions regarding fundamental matters, and has ably and vigorously defended the modern views against the attacks of Berthelot, St. Claire Deville, and others in France. One of the last of these discussions was carried on only a few years ago. It pertained to the question whether Avogadro's hypothesis is valid or not. Many of the most prominent French chemists refuse to accept it, and, in defence of their position, tauntingly refer to two or three apparent exceptions. The particular case which gave rise to the discussion referred to is that of chloral hydrate. Wurtz claimed that the reason why this compound does not conform to the hypothesis is, that, when heated, it breaks up into water and chloral. This his opponents strenuously denied. Both sides introduced very delicate and skilful experiments; but, as is usually the case, no final conclusion

was reached. Nevertheless, a large audience of chemists was interested and instructed by the discussion, and chemistry was benefited.

It would lead too far to attempt to give an account of all that Wurtz has done for chemistry. In addition to the epoch-making contributions mentioned, his synthesis of neurine, his methods for the synthesis of hydrocarbons and of the acids of carbon, his method for the transformation of sulphuric acids into phenols, and investigations on the condensation of aldehydes, are all worthy of much more than ordinary mention. He has also been a prolific writer of excellent books on chemistry, some of which are recognized as standards; and he has been an editor of journals of chemistry, his name being found at present on the title-pages of the *Annales de chimie et de physique* and the *Bulletin de la Société chimique*. The titles of his principal books are included in the following list: Sur l'insalubrité des résidues provenant des distilleries, 1859; Leçons de philosophie chimique, 1864; Traité élémentaire de chimie médicale, 1864–65; Leçons élémentaires de chimie moderne, 1866–68; the Dictionnaire de chimie pure et appliquée, which appeared in parts, beginning in 1868; Traité de chimie biologique, vol. i., 1880; and The atomic theory, one of the volumes of the International scientific series. His Elements of chemistry has been translated into English, and has reached a second edition in this country. His writings are clear, vigorous, and interesting. His fairness as a historian has been questioned; and it must be conceded that his enthusiasm occasionally led him to what calmer men are inclined to regard as incorrect judgment, expressed in strong language. One of his remarks, which naturally aroused the ire of the Germans, is the much-quoted phrase with which he introduced his dictionary: "La chimie est une science française: elle fut constituée par Lavoisier, d'immortelle mémoire."

In 1865, on the recommendation of the Academy of sciences, Wurtz was awarded the imperial biennial prize of twenty thousand francs. In 1867 he succeeded Pélouze as a member of the chemical section of the Academy of sciences. In 1878 he received the Faraday medal from the Royal society of England, on the occasion of his being invited to deliver the Faraday lecture before the English chemical society. In 1881 he was honored with an appointment as senator for life in the French senate.

Imperfect as this sketch is, it will at least serve to show that Wurtz occupied a commanding position among chemists of the present. His loss is a serious blow to science, and especially to the progress of chemistry in France. It will be hard to find a successor possessing his energy and ability. Dumas died a month ago, after having reached a good old age, and after he had ceased to work actively; and while, now that he is gone, we more clearly recognize his greatness, we can nevertheless more readily reconcile ourselves to his loss than to that of Wurtz, who seemed still to belong to the younger generation, capable of guiding others for years to come, and of adding to his former brilliant discoveries.

RESULTS OF DREDGINGS IN THE GULF-STREAM REGION BY THE U. S. FISH-COMMISSION.[1]

6. Evidences of the existence of light at great depths in the sea.

THE evidences of the presence of light and its quality and source at great depths are of much interest. At present very little experimental knowledge in regard to these questions is available. That light of some kind, and in considerable amount, actually exists at depths below two thousand fathoms, may be regarded as certain. This is shown by the presence of well-developed eyes in most of the fishes, all of the cephalopods, most of the decapod Crustacea, and in some species of other groups. In many of these animals, living in two thousand to three thousand fathoms, and even deeper than that, the eyes are relatively larger than in the allied shallow-water species; in others the eyes differ little, if any, in size and appearance, from the eyes of corresponding shallow-water forms; in certain other cases, especially among the lower tribes, the eyes are either rudimentary or wanting in groups of which the shallow-water representatives have eyes of some sort. This last condition is notable among the deep-water gastropods, which are mostly blind: but many of these are probably burrowing species; and it may be that the prevalent extreme softness of the ooze of the bottom, and the general burrowing habits, are connected directly with the absence or rudimentary condition of the eyes in many species belonging to different classes, including Crustacea and fishes. Such blind species usually have highly developed tactile organs to compensate for lack of vision.

Other important facts bearing directly, not only on the *existence*, but on the *quality*, of the light, are those connected with the coloration

[1] See *Science*, Nos. 16, 19, 27.

of the deep-sea species. In general, it may be said that a large proportion of the deep-sea animals are highly *colored*, and that their colors are certainly *protective*. Certain species, belonging to different groups, have pale colors, or are translucent, while many agree in color with the mud and ooze of the bottom; but some, especially among the fishes, are very dark, or even almost black; most of these are probably instances of adaptations for protection from enemies, or concealment from prey. But more striking instances are to be found among the numerous brightly colored species belonging to the echinoderms, decapod Crustacea, cephalopods, annelids, and Anthozoa. In all these groups, species occur which are as highly colored as their shallow-water allies, or even more so. But it is remarkable that in the deep-sea animals the bright colors are almost always shades of orange and orange-red, occasionally brownish red, purple, and purplish red. Clear yellow, and all shades of green and blue colors, are rarely, if ever, met with. These facts indicate that the deep sea is illuminated only by the sea-green sunlight that has passed through a vast stratum of water, and therefore lost all the red and orange rays by absorption. The transmitted rays of light could not be reflected by the animals referred to, and therefore they would be rendered invisible. Their bright colors can only become visible when they are brought up into the white sunlight. These bright colors are therefore just as much protective as the dull and black colors of other species.

The deep-sea star-fishes are nearly all orange, orange-red, or scarlet, even down to three thousand fathoms. The larger ophiurans are generally orange, orange-yellow, or yellowish white; the burrowing forms being usually whitish or mud-colored, while the numerous species that live clinging to the branches of gorgonians, and to the stems of Pennatulacea, are generally orange, scarlet, or red, like the corals to which they cling. Among such species are Astrochele Lymani, abundant on the bushy orange gorgonian coral, Acanella Normani, often in company with several other orange ophiurans belonging to Ophiacantha, etc. Astronyx Loveni and other species are common on Pennatulacea, and agree very perfectly in color with them. These, and numerous others that might be named, are instances of the special adaptations of colors and habits of commensals for the benefit of one or both. Many of the large and very abundant Actiniae, or sea-anemones, are bright orange, red, scarlet, or rosy in their colors, and are often elegantly varied and striped, quite as brilliantly as the shallow-water forms; and the same is true of the large and elegant cup-corals, Flabellum Goodei, F. angulare, and Caryophyllia communis, — all of which are strictly deep-sea species, and have bright orange and red animals when living. The gorgonian corals of many species, and the numerous sea-pens and sea-feathers (Pennatulacea), which are large and abundant in the deep sea, are nearly all bright colored when living, and either orange or red. All these Anthozoa are furnished with powerful stinging-organs for offence and defence; so that their colors cannot well be for mere protection against enemies, for even the most ravenous fishes seldom disturb them. It is probable, therefore, that their invisible colors may be of use by concealing them from their prey, which must actually come in contact with these nearly stationary animals, in order to be caught. But there is a large species of scale-covered annelid (Polynoë aurantiaca Verr.) which lives habitually as a commensal on Bolocera Tuediae, a very large orange or red actinian, with unusually powerful stinging-organs. Doubtless the worm finds, on this account, perfect protection against fishes and other enemies. This annelid is of the same intense orange color as its actinian host. Such a color is very unusual among annelids of this group, and in this case we must regard it as evidently protective and adaptive in a very complex manner.

It has been urged by several writers, that the light in the deep sea is derived from the phosphorescence of the animals themselves. It is true that many of the deep-sea Anthozoa, hydroids, ophiurans, and fishes are phosphorescent; and very likely this property is possessed by members of other groups in which it has not been observed. But, so far as known, phosphorescence is chiefly developed in consequence of nervous excitement or irritation, and is evidently chiefly of use as a means of defence against enemies. It is possessed by so many Anthozoa and acalephs which have, at the same time, stinging-organs, that it would seem as if fishes had learned to instinctively avoid all phosphorescent animals. Consequently it has become possible for animals otherwise defenceless to obtain protection by acquiring this property. It is well known to fishermen that fishes avoid nets, and cannot be caught in them if phosphorescent jelly-fishes become entangled in the meshes: therefore it can hardly be possible that there can be an amount of phosphorescent light, regularly and constantly evolved by the few deep-sea animals having

this power, sufficient to cause any general illumination, or powerful enough to have influenced, over the whole ocean, the evolution of complex eyes, brilliant and complex protective colors, and complex commensal adaptations.

It seems to me probable that more or less sunlight does actually penetrate to the greatest depths of the ocean in the form of a soft sea-green light, perhaps at two thousand to three thousand fathoms equal in intensity to our partially moonlight nights, and possibly at the greatest depths equal only to starlight. It must be remembered that in the deep sea, far from land, the water is far more transparent than near the coast. A. E. VERRILL.

ALPHONSE LAVALLÉE.

DENDROLOGICAL science has met with a great, an almost irreparable loss, in the death of Alphonse Lavallée, the best-known and most successful student and collector of trees of this generation. Twenty-five years ago, under the advice and inspiration of Decaisne, he commenced to gather upon his estate at Segrez, near Paris, the collection of trees and shrubs which has since developed into the richest and most complete arboretum ever established.

Mr. Lavallée did not confine himself merely to the collection and cultivation of trees: he studied them thoroughly and critically, publishing from time to time the results of his investigations.

The nomenclature and synonymy of the forms and varieties of many genera of trees cultivated in the different countries of Europe, long ago fell into an almost hopeless confusion; and, to bring some order out of this confusion, Mr. Lavallée set himself resolutely to work. The results of these investigations were published, ten years ago, in the catalogue of his collections. A second and greatly enlarged edition of this useful work, written with a riper judgment and fuller knowledge, in many critical questions of synonymy, was nearly ready for the printer at the time of Mr. Lavallée's death. He had commenced, too, the publication of the *Arboretum Segrezianum*, of which, however, only five parts had appeared. This sumptuous work, superbly illustrated with figures engraved from steel, contained the descriptions and history of some of the rarest or least-known plants of Mr. Lavallée's collections. His latest published work, a magnificently illustrated folio in which are described *Les clématites à grandes fleurs*, has only just reached the author's correspondents in this country. This was to be followed, in the course of the year, by an illustrated monograph of the genus Crataegus, which has long occupied Mr. Lavallée's attention. His collection of different forms of the species of this most difficult and perplexing genus was unsurpassed, and his opportunities for observing them in a living state unequalled; so that a valuable revision of this genus might have been looked for from his pen.

Mr. Lavallée, at the time of his death, was president of the Central horticultural society of France, and perpetual treasurer of the National agricultural society, and had just declined the professorship in the Museum d'histoire naturelle, lately made vacant by the death of his old master, Decaisne. He had been in ill health for several months, but his death was entirely unexpected. It was caused by aneurism, and occurred at Segrez upon the 3d of May, only a few hours after his return from a long residence in the south of France. Mr. Lavallée was only forty-nine years old at the time of his death. C. S. S.

BURIAL-MASKS OF THE ANCIENT PERUVIANS.

A RECENT contribution to the Bureau of ethnology illustrates one of the most curious of ancient burial customs. It is almost a universal practice with primitive peoples to deposit articles of value with the dead. The ancient Peruvians were most lavish in this respect. Food, raiment, implements, utensils, rich tapestries, and precious articles of silver and gold, as well as objects of superstitious regard, were freely sacrificed.

Most interesting of all these offerings were the mask-like heads generally placed within the outer wrappings upon the top of the mummy pack. At Ancon these objects were usually made of cotton cloth. A small square sack or pillow was made, and stuffed with leaves or seaweed. One side was painted to represent the human face, and to this a wooden nose was stitched. Hair was attached to the back of the head, and a more or less elaborate head-dress was placed upon the crown.

The specimen referred to is of this class. It was obtained from a grave in the vicinity of Lima, and purchased by G. H. Hurlbut of Chicago. It differs greatly from Ancon specimens, but is somewhat similar to an example illustrated by Squier, also from the vicinity of Lima. It is interesting chiefly on account of the heter-

ogeneous collection of ornaments and trophies with which it is bedecked.

The head is of heroic size, the face only being made of wood. This is strongly carved, having a prominent nose, and wide, firm mouth. The eyes are formed by excavating oval depressions, and setting in pieces of shell. First, oval pieces of white clam-shell are inserted, which represent the whites of the eyes: upon these, small circular bits of dark shell are cemented, forming the pupils. Locks of hair have been set in beneath the shell, the ends of which project, representing the lashes of the eye. The wooden part of the mask is flat behind; but the head has been neatly rounded out by a hemispherical bundle of dried leaves, which is held in place by an open net of twisted cords.

Besides this, a great variety of articles have been attached to the margin of the mask by means of five pairs of perforations. Upon the crown a large bunch of brilliantly colored feathers had been fixed: behind this, extending across the top of the head, is a long pouch of coarse white cloth, in which a great number of articles had been placed, — little packages of beans and seeds, rolls of cloth of different colors and textures, minute bundles of wool and flax, bits of copper and earth carefully wrapped in husks, bundles of feathers, etc. Encircling the forehead are long, narrow bands or sashes, one of which is white, the others having figures woven in brilliant colors. The ends of these hang down at the sides of the face.

Attached to the left side of the mask by long stout cords is a pouch resembling a tobacco-bag, about six inches square, the fabric of which resembles a coarse sail-cloth: attached to the lower part of this is a fringe of long, heavy cords. From the opposite side of the head, a net was suspended in which had been placed a variety of objects, — a sling made of cords very skilfully constructed; bundles of flax and cords; small nets containing beans, gourd-seeds, and other articles; copper fish-hooks still attached to the lines, which are wound about a bit of corn-stalk or cane; neatly made sinkers of dark slate wrapped in corn-husks; together with many other curious relics.

These articles were doubtless the property of the departed, so placed in accordance with the established customs of the race to which he belonged. The mask-head was probably in itself an object of much consideration; although we are at a loss to determine its exact use by the living, or its significance as a companion of the dead.

W. H. HOLMES.

MEETING OF THE CIVIL ENGINEERS AT BUFFALO.

THE annual convention of the American society of civil engineers was held in Buffalo, June 10–13, and will be remembered by all who attended as one of the most successful in the history of the society. A spe-

cial train, courteously tendered by the management of the New York, West-Shore, and Buffalo railroad, left New York on the morning of June 9, carrying a large number of members from the eastern states, while many more came from other directions; the total number present, including guests, being between three and four hundred. At the opening meeting, on Tuesday, June 10, the reading of papers was begun; and many of great interest were presented at this and the following sessions. Mr. James B. Francis of Lowell, past president of the society, presented one describing some tests, made under his direction, to determine the efficiency of a Humphrey turbine water-wheel of large power (about 275-horse power), lately put into one of the mills of the Tremont and Suffolk manufacturing company at Lowell. The test showed an efficiency of about eighty-two per cent, which was considered satisfactory. Mr. Francis also presented a paper giving the results of a large number of experiments, which he had made in connection with this turbine test, to determine the coefficients of the formula for the flow of water over a submerged weir, or one in which the level of the water on the down-stream side is above the crest of the weir. Experiments on weirs of this kind have not been very numerous, especially with large quantities of water. The maximum quantity in Mr. Francis's experiments had been somewhat over two hundred cubic feet per second, and his paper gave the proper constants to be used in the ordinary formula for cases of this kind. His results must be considered as of great value, and as forming a worthy supplement to his former extended experiments on ordinary weirs.

Mr. A. M. Wellington read a paper on a line of railroad which he had located from Vera Cruz to the City of Mexico, comparing it with an existing line built some time ago. Although the elevation surmounted was the same in both cases (about 8,050 feet), the old line had a grade of 216 feet per mile for most of the distance, and had cost over three times the estimated cost of the new line, which had a continuous grade of 106 feet to the mile for a distance of about eighty miles, broken in but one place by a level stretch of half a mile, at an important station. This is probably the longest unbroken grade in the world. The maximum curvature was about the same in both lines, though rather sharper in the case of the new line, where the smallest radius was about 300 feet.

Mr. P. C. Asserson of Norfolk gave the results of his experiments in endeavoring to protect wood from the ravages of the Teredo navalis. He had tried some twenty different preservatives, both paints and substances to be injected into the wood, and had found nothing effective except creosote. Leaving the bark on piles, or incasing them in a sheathing of plank, was also stated to be effectual, as the Teredo could not cross a seam, and therefore could not penetrate the pile under these circumstances. In the discussion on this paper it was stated that covering piles with yellow metal had proved effectual, as the animal would not pursue its ravages within the distance so covered, even though it might be able to gain access to the wood on either side of the metal. It was therefore only necessary to cover piles with the metal down to the mud bottom, or a little farther. Driving small-headed nails thickly all over the surface of the pile was also said to have preserved piles for over seventy years, by preventing the entrance and growth of the animal.

Mr. Robert Moore of St. Louis described the landing arrangements for a car-ferry across the Mississippi River at St. Louis. The ordinary range of the water being about thirty-one feet, and the current very swift, the problem had presented some difficulty; and it had been necessary to protect the bank of the river, for some distance above and below, by willow mattresses sunk with stone in the ordinary way. The details of the arrangement adopted were shown by drawings.

Mr. D. Fitzgerald of Boston read a paper on the rainfall at Lake Cochituate, discussing the results of observations extending from 1852 to the present time. His results differ somewhat from those obtained by Mr. Schott, in his work on rainfall, published among the Smithsonian contributions, on account of the longer period at the command of Mr. Fitzgerald.

The application of the water-power of Niagara to the generation of electricity was the subject of an interesting paper by Mr. Benjamin Rhodes of Niagara Falls. He estimated the average power as seven million horse-power, on the total fall, including the rapids above, of two hundred and thirty feet; and the cost of the plant necessary to utilize this power, transform it into electricity, and transmit it anywhere within a radius of five hundred miles, was placed at five thousand million dollars. About six thousand horse-power is now in use at the falls, the greater part on the hydraulic canal, which takes the water from the extreme head of the rapids, and discharges it below the falls, using it on the wheels under heads of from fifty to a hundred feet. Water-power has been used to run a Brush dynamo since 1879, for lighting the grounds of Prospect Park. The speaker calculated that there would be a saving per light, at the city of Buffalo, by using the Niagara water-power instead of steam-power, of forty dollars per annum. The well-known advantages of the water-power at Niagara, as regards steadiness, etc., were dwelt upon.

Capt. O. E. Micharles, U.S.A., discussed the heavy-gun question, taking the ground that it would be better for the government to make large contracts with private establishments for the manufacture of heavy cannon, than to establish a government foundry for their manufacture, and advocating the employment of a Rodman gun, cast from open-hearth steel, annealed from the interior.

The most important business action taken by the society was a vote to memorialize the president of the United States, asking that the president of the society be appointed a member of the international conference to meet at Washington in October next, to fix and determine a prime meridian from which time should be reckoned. The committee on standard

time reported that a great majority of those whose opinions had been sought had expressed themselves in favor of a consecutive numbering of the hours of the day from 1 to 24.

At the evening session on Tuesday, June 10, the society were welcomed to Buffalo by the city officers; and the president of the society, Mr. D. J. Whittemore, delivered the annual address. On Wednesday an excursion was made to the so-called Tifft farm, where improvements are being made, designed to facilitate the transfer of coal from the railroads to the lake vessels. They will consist in an extensive system of docks, excavated on the mainland, together with coal-pockets and other structures for loading into the boats. Near by, an extensive storage-place for coal is provided; the loaded cars being drawn up a long incline of trestle-work, from which they descend by gravity after unloading their coal beneath. The mountain of coal thus formed is penetrated by a wooden tunnel eight feet square, into which cars are run and loaded through sliding doors, when the coal is to be transported to the pockets at the docks. At this place a hundred and twenty thousand tons of coal may be stored during the season, when navigation is closed, or from Dec. 1 to May 1. Although the dock frontage of Buffalo already measures five miles, the Tifft farm improvements will add eight miles more, at an estimated cost of eighty dollars per foot front. The unloading and loading facilities are already so complete at Buffalo, that a two-thousand ton vessel may arrive loaded with grain, and depart loaded with coal, within eighteen hours. There is a growing demand, however, for greater capacity as the lake traffic increases.

Thursday was devoted to an excursion to Niagara Falls and the new cantilever bridge, and on Friday the reading of papers was resumed. Mr. E. L. Corthell, chief engineer of the West-Shore railroad, and formerly in charge of the works at the mouth of the Mississippi, read a paper on the South-Pass jetties, dwelling chiefly upon the lessons which had been taught by their construction. The channel is now nearly straight for two and a quarter miles, and the depth is continually increasing. A survey made last May showed the least depth through the channel to be forty feet except in a few places, and everywhere much in excess of that guaranteed by the contract. Moreover, the jetties had now become thoroughly embedded in the sand, which had become firmly packed into all their interstices, so that their permanence was assured. There was, further, no advance of the bar toward the gulf, although a rapid advance had been predicted by many engineers. The effect on commerce had been very great, and there was now no delay whatever at the mouth of the river; so that New Orleans might be said to have a better channel from the ocean than any other city in America. The results of the work had clearly proved the advantage of a concentration of the force of the current, and had shown that the river could obtain what it could maintain, and that it could not maintain what it could not obtain. Altogether, the result of the works had been in every way satisfactory.

A paper by Mr. Benjamin Reese, on the management of forces engaged in railroad-track repairs, was listened to with evident appreciation by the railroad engineers present.

Mr. E. Sweet, state engineer of New York, contributed a paper on the enlargement of the Erie Canal, arguing, that, in order to be a proper highway, the canal should be large enough to carry the largest lake vessels, or eighteen feet deep and a hundred feet wide on the bottom, with locks four hundred and fifty feet long and sixty feet wide. The cost of the improvements proposed, which would involve a relocation of part of the canal, and the canalization by locks and dams of the Mohawk River, as well as some works on the Hudson, was estimated at from a hundred and twenty-five to a hundred and fifty million dollars; while the probable tonnage was placed at twenty to twenty-five million tons per annum. Thirty years ago the Erie Canal carried nine-tenths of all the traffic between Buffalo and New York, while now it carries less than one-fifth of the total. The paper was followed by one prepared by Capt. Drake of Buffalo, urging the importance and the cheapness of water-carriage.

Mr. J. J. R. Croes of New York read a paper, comparing the water-rates in a large number of cities and towns. Assuming the conditions of a dwelling for seven persons, he found that the rates would vary in different towns from five dollars to seventy-two dollars per annum, and that they were by no means in proportion to the cost of the works. The average rates in different parts of the country were compared, and the advantages of measuring the water delivered to consumers were discussed.

The remainder of the session was devoted to a discussion on the subject of steel, and a comparison between steel and iron for structural purposes; but, on account of the want of time, a number of papers were read by title only.

RECENT OBSERVATIONS ON EXPLOSIVE AGENTS.

JUDGING from the many attempts made to vary the form and composition of 'explosive gelatine,' this method of using nitroglycerine is meeting with favor. As invented by Nobel, it is made by dissolving seven parts of soluble gun-cotton in ninety-three parts of nitroglycerine at a temperature of 35° C. Under the circumstances, the whole mass gelatinizes, and, when cool, is quite a stiff and translucent jelly, insoluble in water, quite insensible to shocks, and holding its nitroglycerine firmly. Unfortunately its stability has become a matter of doubt. Hill, Gen. Abbot, and others have cited instances of spontaneous decomposition during storage; and the writer has recently described the circumstances attending a similar case occurring under his own observation. The cause is believed to exist in the lack of uniformity of composition of the gun-cotton, and the failure to remove from it the last traces of free acid. It is hoped that these difficulties may be overcome.

The variations from the above composition have consisted in varying the proportions given, in the addition of camphor, benzene, and the like substances to increase the insensibility, and of oxidizing and combustible agents to cheapen the cost and modify the force of the explosive. The widest departure from the original explosive gelatine is probably found in the substance styled 'forcite,' invented by J. M. Lewin. This is made by subjecting finely powdered paper stock, or other form of cellulose, to the action of high-pressure steam until the cellulose is converted into a gelatinous mass. This is then cooled and immersed in water, where it preserves its gelatinous form indefinitely. Seven parts of this gelatinized cellulose, seventy-five parts of nitroglycerine, and eighteen parts of nitre are incorporated together over a water-bath at a temperature of 40° C. The result is a whitish, opaque, gelatinous mass. The ingredients are varied by substituting dextrine and ordinary cellulose for a part of the gelatinized cellulose. Judging from some of the descriptions of this powder, various coloring-matters are also used. It is claimed for this explosive, that while it is stable, and holds its nitroglycerine so firmly that it is not separated by sulphuric ether, alcohol, or water, and while it burns in the open air without explosion, yet it may be exploded in a drill-hole by ordinary fuses. Three factories are now producing this explosive in Europe, and one has recently been started on a very extensive scale in New Jersey. These last works are stated to have a capacity of five tons of powder per day. A novelty in these works is the use of India-rubber pipes laid underground for conveying the nitroglycerine from the converting-house to the incorporating-houses.

Among the processes invented for making nitroglycerine, the one devised by Boutmy and Faucher seemed to offer the best assurance of safety, owing to the absence of all energetic action during the operation of conversion. In this process nitric and sulphuric acids were mixed together in equal proportions. A second mixture was then made, with one part of glycerine to three and two-tenths parts of sulphuric acid. When quite cooled, fifty-six parts of the first mixture were mixed in an earthenware vessel with forty-two parts of the second mixture, and allowed to remain from ten to twenty-four hours, when the nitroglycerine was found to have formed quietly, and collected more or less completely on the top of the acids. The failure of the nitroglycerine to separate completely and at once from the acids has been pointed out as a source of danger in the process, since nitroglycerine is decomposed through prolonged contact with strong acids. In spite of this, the process has been in use at the French government factory at Vonges since 1872, and but one accident is recorded. They dealt, however, with comparatively limited quantities, and used pure materials.

Probably the first attempt to apply the process on a commercial scale was made at Pembrey, in Wales, in 1882, where an iron converter was constructed for nitrating fifteen hundred pounds of glycerine in each charge. The process of mixing differed from that used at Vonges, in that, while the final mixing was done there by hand with a wooden paddle, at Pembrey the sulphoglycerine mixture was blown into the acid mixture in the form of a spray, while the acid mixture was being agitated by a blast of air. The process, as thus modified, had been in operation but a few months, when the converter, while containing from five hundred to six hundred pounds of nitroglycerine, was blown up. Col. Majendie has given an extended account of the circumstances in his report, No. 48, to the home secretary; and he considers the explosion due to violent chemical action, established in acid nitroglycerine present in the converter. Dr. Dupré, however, found the glycerine used to be contaminated with fatty acids, while no effort had been made to free the nitric acid from nitrous acid. This lack of care would have led to danger in any process.

Some years since, Dr. Sprengel proposed a convenient and safe way of forming explosives by using oxidizing and combustible agents of such a nature that they could be readily mixed at the place where wanted for use. Several such mixtures have been devised; among others, 'rackarock,' which consists of potassium chlorate and nitro-benzene, and which has given good results. For this explosive the chlorate is furnished in bags of suitable size; and, when wanted for use, these bags are immersed in the liquid nitrobenzene for a determined length of time, when they are ready to be exploded. The most recent explosive of this class, 'panclastite,' is composed of liquid nitrogen tetroxide and a combustible agent, preferably carbon disulphide, in the proportion of three volumes of the first liquid to two of the second. The heat developed by the combustion of this mixture is estimated at about 3000° C.; and, when burning freely, the light is so bright as to equal that of the calcium light. The inventor claims that its explosive power, when confined, surpasses that of dynamite; but the French explosive commission, when using Abel's lead cylinder test, obtained a slightly less value. With a mixture of equal volumes of nitrogen tetroxide and of nitrotoluene, however, they obtained the same value as for dynamite No. 1. Notwithstanding the power of the panclastite mixtures, it is questionable whether such a substance as nitrogen tetroxide can be brought into any general use.

While much attention has been given to the high explosives, the claims of gunpowder have not been overlooked; and many changes have been proposed in the form, size, shape, and density of the grain, and in the mode of manufacture and composition of the mixture. The most novel among these is the hydrocarbon-powder, made from a mixture of nitre or potassium chlorate with a solid hydrocarbon, such as paraffine, asphaltum, India-rubber, and the like. The incorporation is effected by the aid of a volatile liquid solvent, which dissolves the hydrocarbon, and furnishes a plastic mass, which may be moulded into any desired form, and then hardened by allowing the solvent to evaporate. A peculiar advantage claimed for the powder is its imperviousness to water.

A variety of gunpowder made by the Rottweil-

Hamburg powder company at Duneberg, is, however, attracting the most attention on account of the high initial velocities and low pressures which it has actually given in practice. The grains weigh about forty-two grams, have a specific gravity of 1.86, and have the hexagonal prismatic form so generally adopted in Europe, with one canal. They have the color of cocoa; and from this characteristic the powder has become known as 'cocoa' powder. The reddish hue seems to be due to red-burned charcoal. Powders heretofore made with red coal have been found to be readily inflammable, and to explode with dangerous brusqueness, producing high local pressures; and hence care has been taken to select only well-burned black coal for the manufacture of military gunpowders. In spite of the fact that 'cocoa' powder contains red coal, it has been found by experiment, that a grain of it burns slowly and with very slight deflagration, when ignited in the open air; and that a mass as great as fifty-five kilograms, when enclosed in a wooden box and ignited, burned slowly, without exploding, and simply raised the cover of the box without displacing it. This may be owing to the large percentage of charcoal, the low percentage of sulphur, and the high specific gravity; but the slowness of combustion is equally marked when a grain is crushed to meal-powder; and it is probable that there is a difference in the kind of charcoal, as well as in the quantity. In addition, it is claimed that this powder is but slightly hygroscopic, and yields very little smoke. The advantage of this last-mentioned property is shown by the recent experience at Alexandria, where the English were compelled from time to time to cease firing, to allow the smoke from their guns to clear away; and in the Sudan, where the English were blinded by the smoke, under which the enemy crept upon them. On the other hand, it is stated that 'cocoa' powder fouls badly.

With gunpowder, as with all mechanical mixtures, the uniformity of the product depends largely upon the thoroughness of the incorporation. To test gunpowder for this most important condition, it is customary to flash a quantity upon a plate of glass, and to examine the residue; but the deliquescent and perishable character of the deposit necessitates immediate examination, while long and frequent experience with the test is required in order to enable one to draw a proper conclusion from the observation. Col. Chabrier has proposed the use of paper, colored blue by starch and potassium iodide, upon which to make the flash, the color being discharged by the combustion of the powder. The test-papers of this process, however, are also evanescent, and the trained memory must be relied upon in reaching a decision. The writer has recently proposed the use of a paper colored with Turnbull's blue, such as is produced in the 'blue-print' process of photography; since the color of this paper is discharged by the action of such alkaline salts as are formed in the combustion of gunpowder. For use, the paper is dampened; the powder is placed upon it in a uniform heap, and then flashed. The paper is exposed to the action of the residue for half a minute, and then washed in running water, and dried. The result is, that, wherever a globule has rested, the color is bleached. It is believed that these spots will be smaller and more uniformly distributed as the incorporation approaches completeness, provided the state of the different samples tested is otherwise the same. These test-papers can be preserved without change, and may be filed as standards for comparison, or forwarded to experts for examination.

CHAS. E. MUNROE.

NOTICES OF ETHNOLOGIC PUBLICATIONS.

THE ethnology of the Eskimo, better called Innuit people, is to us of an ever-renewed interest, not only on account of the researches around the arctic pole, in the furtherance of which this race has been eminently helpful, but also for the peculiar ethnographic position of the people among the other American nations. Dr. Franz Boas has discussed the present seats of the Neitchillik-Eskimo, first seen by Sir John Ross (1829–33), and recently visited by Lieut. Schwatka, and illustrates his article by a topographic map.[1] Another article of singular interest, by Edward B. Tyler, deals with "Old Scandinavian civilization among the modern Eskimos," with two plates,[2] and contains a large amount of facts new to science. Bering's Straits, considered as the 'bridge' between the two continents and hemispheres, necessarily calls the attention of all ethnologists to the tribes inhabiting both sides of it. The ethnographic relations of these are expounded with minute care by Prof. G. Gerland of the Strasburg university, in a paper inscribed "Zur ethnographie des äussersten nordostens von Asien."[3] The tribes on the Asiatic side are described from the accounts given by the latest travellers, and old errors concerning them are refuted.

Rev. J. Owen Dorsey, formerly missionary among the Ponka Indians, and a specialist in the study of all tribes and languages of the Dakotan family, has given a lucid 'account of the war customs of the Osages'[4] as the result of a visit to that tribe, made in 1883. These interesting war and hunting customs are chiefly based upon the gentile or totem-clan system. The rules observed in encamping and other military acts were most rigidly and unalterably enforced, perhaps more so than our own military regulations, and through their archaic forms testify to a high antiquity. Customs like these may be traced among all the warlike tribes of the Mississippi plains, even at the present time, when they are hedged in within the narrow limits of Indian reservations. Numerous illustrations facilitate a clearer understanding of the practices described.

Dr. W. J. Hoffman presents us a "Comparison of Eskimo pictographs with those of other American aborigines,"[5] interspersing his article with numerous

[1] *Zeitschr. gesellsch. erdk. Berlin*, xviii. 222.
[2] *Journ. anthrop. inst.*, 1884, 348.
[3] *Zeitschr. gesellsch. erdk. Berlin*, xviii. 194.
[4] *Amer. nat.*, 1884, 113.
[5] *Trans. anthrop. soc. Wash.*, ii. 128.

illustrations and linguistic scraps. Another paper,[1] by A. S. Gatschet, discusses his ethnologic and linguistic observations made among the Shetimasha Indians of St. Mary's parish, La.

Ethnologic results of a visit, made in 1883, to two Iroquois reservations in New-York state, are published in French and in Dutch by Dr. H. ten Kate, who in the same year made somatological and other researches among the Indians of the south-west of the United States and the north-west of Mexico, including the peninsula of California.

Wood-carvings of the Haida and other tribes of the north-west coast of North America are figured upon thirteen splendidly colored plates, with descriptive letter-press, in a folio volume entitled 'Amerikas nordwestküste; neueste ergebnisse ethnologischer reisen.' The objects represented consist of masks of human and animal shape; of implements, such as spoons, vases, rattles; of troughs, posts, idols, and other wood-carvings, — all of which are now exhibited in the collection of the Berlin royal museum. This folio was published by Asher & Co., in Berlin, under the auspices of the direction of the ethnologic department in the museum in 1883 (Dr. Adolf Bastian); and an English edition was issued in the same year.

The political and social condition of the Liberian negroes, an immigration from North America into western Africa, is discussed in a long and very elaborate article read to the Geographical society of Berne, Switzerland.[2] The capital of this Ethiopian republic is Monrovia: the population consists of two elements quite distinct from each other, — the aboriginal negroes and the immigrated settlers. Slavery is nominally abolished by the constitution of the republic; but a substitute has been found in the so-called 'bushniggers,' whose only toilet consists in a handkerchief worn about their loins. The Liberia constitution proclaims full liberty of religion, conscience, of speech and press, and gratuitous education of children; and one of the more noticeable paragraphs precludes white people from acquiring any real estate, and from being intrusted with any public office. J. Bütikofer, the author of the article, gives many observations and personal experiences from his travels in the interior and on the coast of Liberia.

An excellent ethno-archeological publication on Bavaria, which deserves more than a passing notice, is published under the title, 'Beiträge zur anthropologie und urgeschichte Bayerns.' These contributions are the organ of the Munich society of anthropology, ethnology, and prehistorics, being issued in four numbers to a volume of lexicon-octavo size, and profusely illustrated. Under the editorship of Joh. Ranke and Nic. Rüdinger, five volumes have been issued up to the present year. The most extensive and difficult topic now engrossing the attention of that scientific body is the publication of the archeologic map of Bavaria, — a land which covers an area of 75,000 □ kilometres, and has been in its more level parts thoroughly explored by archeologists for remains of antiquity. Of the fifteen sheets of the map, five have been issued by the editor in charge, Prof. F. Ohlschlager, who uses over twenty colored sign-marks for the objects discovered, and adds a statistical and topographic register of the finds. The occurrence of all the 'hochäcker,' a relic analogous to the 'garden-beds' of the American north-west, has been represented on a separate map in the fifth volume: they are almost entirely limited to the southern parts of Bavaria, extending between Augsburg and Salzburg.

[1] *Trans. anthrop. soc. Wash.*, ii. p. 148.
[2] *Jahresb. geogr. gesellsch. Bern*, v. 75.

MENTAL EVOLUTION IN ANIMALS.

Animal intelligence. By GEORGE J. ROMANES. New York, *Appleton*, 1883. (International scientific series.) 498 p. 8°.

Mental evolution in animals. By the same. New York, *Appleton*, 1884. 384 p. 8°.

IN the wide range of interesting facts collected and published a year ago in 'Animal intelligence,' Mr. Romanes laid a broad foundation for his present work, 'Mental evolution in animals;' and these volumes, we find, are preliminary to a forthcoming work upon 'Mental evolution in man,' which will complete the most extensive study of comparative psychology ever attempted. This subject has not hitherto received the comprehensive treatment which its importance deserves. One of the most vital questions of our times is the genetic continuity of the mind as well as the physical structure of man with that of the lower animals: it marks the point where the views of Darwin and Wallace, and of many of their followers, diverge; and, whatever our own opinions may be, we must regard this as the crowning problem of animal evolution in its broadest sense. In the first few pages of these two works, it is easy to discern the author's personal standpoint, and to foresee that the third volume will contain an elaboration of the psychology of the 'Descent of man.' Reserving, however, a complete discussion of the final question for the later work, he carries us here to the summit of the lower animal scale, ably following every line of inquiry. Although not a profound thinker, Mr. Romanes is a thorough and original investigator; and his previous labors, both in biology and psychology, qualify him peculiarly for this line of research. While as a philosopher he generally follows Hume, Mill, Bain, and Spencer, his position as a psychologist is often very independent. As a follower of Darwin, he naturally inclines strongly to his views on many questions; attributing to natural selection almost unlimited influence in the development of instinct and intelligence.

Based upon the generally accepted truth of the evolution theory, below the human scale,

the plan of the work is, first, the collection of a vast number of authentic observations upon the lower animals (this, with general comments, occupies the whole of the volume upon 'Animal intelligence'); second, a close analysis of the tests of mind, its physical basis, and the means we have of determining its presence; third, an examination of the mental faculties, such as consciousness, sensation and perception, instinct and reason, in their higher and lower manifestations; fourth, the application of actual observations to the determination of the various levels in the animal scale at which these phenomena of consciousness, sensation, and so on, appear; finally, a full discussion of the problem of instinct, as arising parallel with intelligence. The chief merits, as well as the special and almost insurmountable difficulties of Mr. Romanes' work, are met with in these last two sections. In the accumulation of well-ascertained facts, he has started in a sound scientific method: the interpretation of these facts is a most delicate task.

Is a certain act prompted by instinct, or intelligence? Does it indicate conscious choice, or merely the response of reflex action to a certain stimulus? Does it indicate a knowledge of the relation of means to end? These are subtle problems all along the line from the anthropoid ape to the Amoeba: their interpretation by the two schools of psychologists is often directly contradictory, yet upon this the whole argument must rest. The difficulties increase as we descend the scale. The minds of others can only be known as ideal projections of our own mental states. Here arises the doubt, in applying our criteria of mind to particular cases, which increases as we recede from minds like our own to those less so, passing into a gradual series to not-minds.

The observations in the first volume under consideration relate to members of all the larger divisions of the animal kingdom. Their number and variety are surprising; and, although the author has carefully endeavored to exclude all those in the least degree doubtful, many of them will appear incredible to persons unfamiliar with this class of literature. These anecdotes form a superb field for induction; yet many of them are marred for scientific purposes by the hasty conclusions of the observers, which are appended. In the closing chapter upon monkeys, there is a novel diary of the habits of a brown capuchin, which was written for two months by Miss Romanes.

In the second volume, before seeking to determine the levels at which we meet the lower and higher mental phenomena, the author tries to show very clearly his own conception of mind, and by what means we can legitimately infer its presence in an animal. "The distinctive element of mind," he says, "is consciousness, and the test of consciousness is the power of choice." The function of selective discrimination with the complementary power of adaptive response is regarded as the root-principle of mind; and it is found only in agents which are capable of feeling. These root-principles of feeling and choice may be traced down into the vegetable kingdom, where, for example, we find an insectivorous plant rejecting a bit of glass, but feeling and closing upon a fly. To the objection that plants are not in any proper sense capable of feeling, the author allows that at the bottom of the scale the terms have lost all their original meaning; yet the apparent abuse of terms serves well to emphasize the fact of the gradual dawn of these powers. The great stress of Mr. Romanes' argument, as a consistent evolutionist, is the universal gradation which we find throughout the scale, which he strictly maintains is one of *degree* only, although it may appear to be one of *kind*. With this principle of gradation constantly in mind, the reader will be less surprised at some of the author's conclusions.

We see feeling and choice acquiring the semblance of their higher meaning among the coelenterates, in the Medusae for example, where we first find definite sense-organs. In this group, accordingly, following Spencer, the author discovers 'the raw material of consciousness.' Here arises another difficulty in distinguishing between the mental choice of consciousness, and the apparent, but not real mental choice of reflex action; and the only distinction that can be drawn consists in the latter "depending on inherited mechanisms within the nervous system, being so constructed as to effect *particular* adaptive movements in response to *particular* stimulations, while the former are independent of any such inherited adjustments." Reflex choice is habitual and invariable: mental choice decides between one of two alternatives, in case of new experience. Sensation is feeling aroused by a stimulus, and always attended by consciousness; and, together with the rise of conscious choice, we meet the dawn of intelligence, or mind as we generally understand it. Does the organism learn by its own individual as distinguished from its race experience? If it does so, its mind is placed beyond the area of merely reflex action.

Having advanced thus far, the author first

discovers memory of a low order among the gastropods; experiments with the echinoderms and higher crustaceans having, up to this time, given rather negative results. The latter fact is the more surprising; because among some of the terrestrial arthropods — the ants, bees, and wasps — this faculty is so wonderfully developed. Memory of the higher kind, which depends upon the association of ideas by similarity, is met with among the fish and batrachians. This involves another faculty; namely, perception. Differing from Spencer in many particulars, and showing less confidence in himself as to the rise of perception than at other points, the author in general regards it as the faculty of cognition, and finds clear evidence of it among the insects, reaching the general conclusion that reflex action and perception advance together. Imagination is stated to rise step by step with memory and perception among the mollusks, insects, spiders, crustaceans; and the doubting reader is referred to the actual observations in 'Animal intelligence' which sustain these conclusions. As to the more complex mental powers, proceeding in the same line of argument, the author discovers reason, with a knowledge of the relation between means and end, among the bees and wasps; in this order he also observes communication of ideas; understanding of words, and dreaming, are found among the birds; tools are intelligently used by monkeys and elephants; an indefinite sense of morality is seen among dogs and anthropoid apes. The discussion of conscience, volition, and abstraction, is reserved for the last volume. The various approximate levels at which the signs of the emotions, the will, and the intellect appear, are presented in a large diagram, in which the faculties branching out from a single stem, neurility, are seen in a condensed view of the entire system.

Fully one-half of 'Mental evolution in animals' is devoted to the subject of instinct; and as it is treated with the utmost fulness and clearness, with a critical discussion of the theories of different writers, it forms an invaluable and standard contribution to this much mooted subject. In general, supporting the theory of Darwin in opposition to the contradictory views of Lewes and Spencer,[1] it is shown that the origin of instincts may be either primary or secondary; that is to say, —

"Instincts may arise either by natural selection fixing on purposeless habits which chance to be profitable, so converting these habits into instincts (primary), without intelligence ever being concerned in the process; or by habits originally intelligent becoming by repetition automatic (secondary)."

While either of these causes may work alone, yet frequently in co-operation they evolve instinct more rapidly by blended origin. Instinct is accordingly defined as "reflex action into which there is imported the element of consciousness;" and the point is ably sustained, that Spencer's derivation of instinctive from reflex actions merely, is inadequate for the higher animals, while Lewes's theory of the 'intelligence' origin is inadequate to explain the instincts of the lower animals. Darwin's essay on instinct, part of which only appeared in the 'Origin of species,' is published as an appendix to this volume. The author acknowledges his indebtedness to this, as well as to many manuscript notes left him by the great naturalist.

An outline has been given of these unusually interesting works; and there is little space left for extended criticism, although at many points it is richly deserved. We find, among other defects, that the candor of the author's preface is not sustained throughout. He disclaims the discussion of all philosophical questions, such as the causal relations between mind and matter, as apart from the objects of the book; yet, at several rough places where he feels called upon to explain the origin of faculties, he does it in terms of nerve fibres and cells. For example: in the origin of consciousness we find him groping after Spencer, and, with some hesitation, deriving this faculty from 'ganglionic friction;' while at another turn he reverses the causal relation, since it is convenient to do so, and suggests a psychical cause for some material change. Discussing the origin of nerve-fibres, he again quotes Spencer; although Balfour, in his address before the British association in 1880, gave the whole weight of his authority against Spencer's theoretical views. The accounts given of the evolution of the first germs of mind and nerves are necessarily obscure and assailable. It is true that pure speculation is unavoidable in such an intangible sphere of inquiry; but the intrinsic merits of the argument are dimmed, and we believe the truth is delayed, when the reader is so often left in doubt as to where the author's observation ceases and his imagination begins. As before stated, it is not the facts of actual observation brought forward, but the character of the inferences which are drawn from these facts, which will arouse controversy.

The American edition of 'Mental evolution'

[1] In his Principles of psychology. This work was written before the publication of the Origin of species. Mr. Spencer now admits the wide influence of natural selection.

is a careless publication. Besides numerous typographical errors, those who were unfortunate enough to purchase an early copy found two important diagrams omitted, one of which is absolutely essential to the understanding of the context.

FISKE'S ELECTRICITY.

Electricity in theory and practice; or, the elements of electrical engineering. By B. A. FISKE. New York, *Van Nostrand*, 1883. 270 p. 8°.

THAT the work of Lieut. Fiske meets in some degree a want felt by a considerable number of persons, is sufficiently shown by the fact that it has already reached a third edition; but we must nevertheless confess to a feeling of serious disappointment on reading it. The expectations raised by the title are hardly justified by the contents; since the discussions of theoretical points are very brief and unsatisfactory, while the portion treating of electrical engineering proper is somewhat ill-digested. In fact, there is a certain 'scrappiness' about the work as a whole, which is apparently due to over-haste in preparation.

The first five chapters, occupying about one-fourth of the book, are extremely elementary, and contain little that will not be found more fully stated in almost any work on electricity, while occasional loose statements also occur. Thus, in the chapter devoted to work and potential, the writer seems to overlook the exactness introduced into scientific measurements when Gauss first proposed an absolute system of mass and force measurement. Immediately after the definition of the foot-pound, we find the following statement: "This unit is, however, too large for measuring with convenience in many cases; and for this reason a much smaller one has been invented, called the 'erg.'" The only definition given of the dyne is "an extremely minute weight, being about $\frac{1}{981}$ of a gramme." Other examples are to be seen in the table on p. 214.

Such laxity of expression, although it may seem to simplify the subject, cannot fail to prove confusing as soon as the reader really begins to study the matter. Similar want of care in expression will trouble the student while reading certain parts of the chapter on the laws of currents. From the statements on p. 60, regarding the arrangement of battery-cells, the reader might erroneously infer that high internal resistance in a cell is in itself advantageous in increasing the strength of the current given by a battery.

Considering the portion of the work devoted to the applications of electricity, we find a great inequality in the space devoted to important matters. The subject of electro-metallurgy is allowed but a single page, and the extensive use of dynamo-machines in the electrical deposition of metals is not discussed at all. Of the ten pages given to storage-batteries, five are filled with a mere statement of the claims of certain recent patents, without any information regarding their value. On the other hand, neither the chemistry of the lead-battery nor the special advantages and disadvantages of the storage-battery are considered. The chapter on thermo-electric batteries contains no allusion to any form of thermo-battery whose use in the arts has been attempted; and there is not even a mention of the names of Farmer, Noë, or Clamond. Instead of this, five pages of patent claims are given, several of which are not, in fact, for thermo-electric batteries proper.

The remainder of the work deserves somewhat more praise. The chapter on electrical measurement contains a description of the earlier forms of ampère-meter and volt-meter of Deprez and Ayrton and Perry. There is no reference to Sir William Thomson's current and potential galvanometers. Under telegraphy we find the bridge duplex method described, but the differential method is not alluded to. The principles of the quadruplex, as well as those of the harmonic telegraph, are, however, explained. The chapter on the telephone is interesting. It is unfortunate that not even a passing mention is made of the Blake transmitter; while the rarely used transmitter of Edison, and his ingenious but unpractical electro-motograph receiver, are described at some length. The following chapters on electric lighting, dynamo-machines, etc., are, on the whole, the best in the book. The principle of the differential arc-lamp is explained, and brief descriptions are given of most of the leading types of dynamo-machines. The closing chapter on electric railways contains, among other matters, an account of the system of Field and Edison.

In justice to the work under review, we ought to say that many of the faults which we have criticised have their origin in the fact that our author has attempted the impossible feat of discussing the theory and practice of electrical engineering in a work of only two hundred and sixty-five pages. As a consequence, neither theory nor practice is described at sufficient length to meet the wants of the reader. Moreover, we are firmly of the opinion that any one

wishing to understand the applications of electricity must first acquire a thorough knowledge of the theory. Having secured this, he will find no trouble in reading any works devoted to the practice of electrical engineering.

AMERICAN COASTER'S NAUTICAL ALMANAC.

The American coaster's nautical almanac for the year 1884. Published by authority of the secretary of the navy. Washington, *Bureau of navigation*, 1884. 158 p. 8°.

It has long been customary for the principal dealers in chronometers, hydrographic charts, and navigation supplies generally throughout the country, to publish annually, in cheap pamphlet form, certain of the fundamental data required in the navigation of ships, and compiled largely from the publications of the 'Nautical almanac' office. Such small prints have commonly been disposed of for a few cents per copy, or given away to masters of vessels, as the tabular data were so scattered among advertisements of the wares of these dealers as to render their distribution a matter of interest to the publishers.

The recent action of the superintendent of the 'Nautical almanac' office, in beginning the regular issue of the 'American coaster's nautical almanac,' will, it is to be hoped, put an end to this unauthorized extraction from the publications of the scientific offices of the government; for the new annual will contain, in a compact and convenient form, the ephemeral data of every sort required by navigators along the American Atlantic coast, and is issued under the official sanction of the secretary of the navy. The 'Coaster's almanac' is made up from data already in good part accessible to navigators in one form or another, but which are now, for the first time, brought together into a single small volume, obtainable with little trouble and expense.

We have first the elements pertaining to the position, motion, and apparent magnitude of the sun, together with the equation of time, — all given for Greenwich noon, as in the larger annuals of the same office. Following are the times of the moon's phases, — where, by the way, the meridian is omitted, and a doubt is likely to arise whether they may not be applicable to some meridian other than Greenwich, — underneath which we find the sidereal time of mean noon, and blank columns left for the navigator to enter with every day the necessary data regarding his chronometer, and the latitude and longitude of his vessel at noon. The next succeeding pages contain the positions of a hundred and fifty fixed stars for the beginning of the year, followed by a table for finding the latitude by an observed altitude of Polaris, and a table for converting solar into sidereal time. A matter of some account is the omission from this portion of the 'Coaster's almanac' of all data regarding the planets. A half-dozen additional pages would have sufficed to give the positions of the four bright planets ordinarily employed by navigators, with precision enough to make them quite as useful as the list of star-positions.

The astronomico-nautical data occupy nearly forty pages, or about one-fourth of the entire book. Following are twenty pages of tidal data, compiled from the complete tide-tables published by the office of the coast and geodetic survey. The approximate predicted times of high water at the principal ports on the Atlantic coast of the United States are given for every day of the year; while, for intermediate ports, tables of tidal constants are added. The times of high water are reduced to the standards of the eastern and central meridians, respectively five hours and six hours slow of Greenwich time.

We have next a very comprehensive list of more than five hundred lighthouses, lighted beacons, and floating lights, on the Atlantic and Gulf coasts of the United States, occupying thirty-five double pages, and giving the name, location, characteristic, and order of each light; also the geographical position, height above the sea-level, maximum distance at which visible, the color and peculiarity of the lighthouse or vessel, and the character of the accompanying fog-signal. This is followed by a ten-page list of lights in the West-India Islands, and on the adjacent coasts, the coast of Brazil, etc., to the Magellan Straits, similar data being likewise given for these lights. The 'Coaster's almanac' concludes with nautical directions for manoeuvring in, and avoiding the centre of, cyclones in the North Atlantic; the twenty-six articles of the revised international regulations for preventing collisions at sea; general information regarding life-saving stations, with instructions to facilitate the shipwrecked mariner in receiving the assistance of these stations; and, finally, descriptions and explanations of the signals displayed by the army signal-service as cautionary against approaching storm, severe winds, and rough weather generally.

The new almanac bears in every part the marks of preparation with a considerate regard for the wants of that class of men likely to use it; and the make-up of its contents has evidently been in large part suggested by, or under the direction of, some officer fully acquainted with the routine and necessities of practical navigation; and subsequent issues may be expected to contain many additional improvements. The 'Coaster's almanac' is not intended to replace the 'American nautical almanac,' or navigator's edition of the large 'Ephemeris,' which has been issued by this office for each year since 1855, and will be continued as heretofore.

METALLURGY OF PRIMITIVE NATIONS.

Die metalle bei den naturvölkern, mit berücksichtigung prähistorischer verhältnisse. Von R. ANDREE. Leipzig, *Veit & Co*, 1884. 10+166 p., 57 illustr. 8°.

IN our epoch the primitive status of savage nations rapidly disappears, and the manufacture of the last tools recalling the stone age will soon be abandoned. The factories of New England already furnish cast-steel tomahawks to our western Indians, and the Central-African negro shoots the hippopotamus and elephant with a breech-loader of the most recent pattern. Facts like these are a sufficient warning to the ethnologist for collecting *now* whatever can be brought to posterity from the implements and rude machinery of the lower races of mankind. To aid this purpose, Andree has undertaken to illustrate one branch of ethnologic research, metallurgy, and to show the extent of our present knowledge concerning its practice among the above races.

His learned treatise excludes the European and Semitic nations, of which the metallurgy is sufficiently known, and had, except within the most recent times, but little direct influence upon that of primitive nations. The most important metals to be considered were iron, copper, tin, and bronze. The Egyptians of the earliest period were acquainted with bronze and iron; but the manufacture of iron tools by the Central-Africans was an invention of their own, and not borrowed from Egypt. It first developed in north-eastern or in Central Africa, and from there must have reached southern Africa, as Andree believes. Iron tools followed immediately upon stone tools, since copper is limited to a few portions of that continent only. The East Indies had a stone period for themselves; and metals, except tin, do not seem to have been imported there. Copper is obtained by very archaic methods. It cannot be decided which metal, copper or iron, is of older use in that country.

The Malayan nations form another independent area or domain of metallurgy, their peculiar practical methods reaching from Madagascar to New Guinea. Iron was their oldest metal, and it probably was so among the Indo-Chinese as well. In its cultural development, China stands wholly for itself, and thirty-five hundred years ago it produced the finest bronzes; but Chinese prehistorics have not as yet been sufficiently studied to decide which metal was the first to be wrought in that distant realm. When Russia invaded Siberia, some of its tribes were reducing and working iron ores, having been probably taught by Turkish nomads. Meteoric iron was put to use by several American tribes, especially by the Eskimo. The reduction of ores by charcoal, and their smelting by fire, were discovered at three different spots in this western hemisphere, wholly independent of each other, — in Mexico, in Cundinamarca, and in Peru. The chief metal of Mexico was copper; of Peru, bronze; though both were used simultaneously with stone implements. Analyses made of American bronzes have proved them to be alloys of metals joined in very different proportions.

The 'Scandinavian' theory, that in every part of the world the metals should appear in the same historic order — copper, tin, bronze, iron — among all, even the most heterogeneous nations, has held supreme sway in science for almost half a century, but is now entirely upset by the investigations of R. Andree and others. A fact which alone would suffice to disprove it is this, that the production of bronze is a more difficult process than the production of iron. Many nations have borrowed metallurgic processes and methods from other nations, as proved in many instances; but these methods and practices have also been the result of inventions independent of each other; and, to explain the similarity of processes in countries widely separated from each other, the assumption of separate invention is the most probable and natural of all.

Although the above results gleaned from Andree's publication give only a superficial idea of its contents, we deem them sufficient for attracting the notice of ethnologists and archeologists, and add the statement that every page of it teems with important or unexpected disclosures.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Yellowstone national-park survey. — Preparations for field-work by the Yellowstone park division, under Mr. Arnold Hague, are now nearly complete. The experience of last season enables the members of the party to take the field with a fair idea of the nature of the volcanic rocks of the park, and of the thermal problems with which they will have to deal. Last summer's notes have been condensed and arranged for the purpose of comparing the conditions of the springs and geysers observed with their conditions during the corresponding months of this year. A comparison of the thermal activity observed in 1883 with the intensity displayed in 1878 shows, that in the greater number of instances the changes have been unimportant, and that, contrary to the opinion frequently stated, there has been no diminution in the intensity of thermal action in the park during the last six years.

Mr. Hague reports that two additions should be made to the list of active geysers, — one in the Firehole basins, in the lower geyser basin, and one in the upper basin. The former is situated on the broad sinter terrace or flat, that lies north-west of the mounds of the 'Fountain Geyser.' Dr. Peale, in his report of 1878, suggests the possibility of its being a geyser. It has a large, gray pool (ninety to a hundred feet in diameter), without any particular beauty of form or color. Near the west border of the pool is a fissure-like vent, over which the water, owing to its greater depth there, has a dull-green color. The following description of an eruption is from the notebook of Mr. Walter H. Weed: —

"At 5 P.M. (Sept. 25, 1883) the water was perfectly quiet, no ebullition whatever being noticed. At 5.02 a large volume of steam was thrown out, accompanied by a vigorous bulging of the water, which increased in violence until at 5.05 a mass of water, six to eight feet in diameter at the base, was thrown up in a tapering column from twenty-five to thirty feet high. For twenty seconds these spurts continued, after which the column fell, and the water boiled quietly for ten seconds. Bulging again commenced, and continued, with occasional subsidence, until 5.13, the jets varying in height from three to twenty feet. The total duration of the eruption was eleven minutes. From 5.13 to 5.43 the water boiled quietly; at the end of this time bulging again commenced, and another eruption similar to the first occurred. There are apparently two vents; the jets acting together, yet not perfectly synchronous. A low, heavy mass is shot up from the lesser vent."

This geyser has been named the 'Surprise.' From the height of the column and force displayed, it will rank as the third geyser in the Lower Basin.

The new geyser of the Upper Basin is in the Emerald group, and is the spring No. 9 of that group, described in Dr. Peale's report. Mr. Hague has named it the 'Cliff Geyser,' as it lies so close under the wall which skirts the west bank of Iron Creek. Mr. Weed was fortunate to witness this geyser in action, and describes an eruption, under date of Aug. 27, 1883, as follows: "This geyser presents a shallow basin, with rather ill-defined margin, formed of thin plates of honeycombed geyserite. The water near the edge is turbid, and from two to eight feet deep, and, when first observed in action, was boiling vigorously at a number of points. A few minutes later the water bulged violently to a height of six feet in the centre of the basin, sending out waves in all directions, which broke upon and ran over the low margin. This was soon followed by another bulge eight feet high, succeeded by a series of spurts and bulges lifting the central mass of water to a height of thirty to fifty feet. This continued for two minutes and a half, when the violence of the eruption became less and less, until the jet was but three to eight feet high, continuing for two minutes, when the water receded, still boiling vigorously. The inner basin was now seen to be approximately thirty feet in diameter, with a somewhat muddy bottom, blotched with black and orange, surrounded by a shallow, gray-white and black-lined outer basin, fifty by sixty feet. Half an hour later a second eruption occurred, quite similar to the first. These eruptions resemble those of the Giantess in appearance."

U. S. bureau of ethnology.

Annual reports. — The third annual report is all in type, and will soon be issued. The second report is now being issued: it is a volume of five hundred and fourteen pages (i.-xxxvii., 1-477), illustrated with seventy-seven plates, seven hundred and fourteen figures, and two maps. Thirteen of the plates are chromolithographs. The report of the director details the office and field work of the bureau for the fiscal year 1880-81, and presents some remarks introductory to the accompanying papers, which immediately follow. These are seven in number: viz., 'Zuñi fetiches,' by Frank Hamilton Cushing; 'Myths of the Iroquois,' by Erminnie A. Smith; 'Animal carvings from the mounds of the Mississippi valley,' by Henry W. Henshaw; 'Navajo silversmiths,' by Dr. Washington Matthews, U.S.A.; 'Art in shell of the ancient Americans,' by William H. Holmes; 'Illustrated catalogue of the collections obtained from the Indians of New Mexico and Arizona in 1879,' by James Stevenson; and 'Illustrated catalogue of the collections obtained from the Indians of New Mexico in 1880,' by James Stevenson.

Mr. Cushing's paper occupies thirty-seven pages. The fetiches most valued by the Zuñis are natural concretions or eroded rock forms, having an obvious or fancied resemblance to certain animals, or objects of that nature, in which the evident original resemblance has been heightened by artificial means. Eleven plates and three figures show a number of these fetiches, three of the plates being colored.

It is the plan of the bureau to preserve and record

the myths and folk-lore of the several tribes in their own languages, with interlinear translations. The paper of Mrs. Erminnie A. Smith, although it does not in this volume present the original language, is written after the reduction of the original to writing in the course of her linguistic work, after a prolonged residence among the Iroquois tribes, into one of which, the Tuscarora, she was adopted. It is therefore an authoritative rendering of some of the Iroquois myths, some of which have appeared in other fōrms, and others of which have been for the first time collected by herself. Mr. Henshaw, in forty-four pages, discusses the animal carvings from the mounds of the Mississippi valley, and reaches the following general conclusions: —

1°. That, of the carvings from the mounds which can be identified, there are no representations of birds or animals not indigenous to the Mississippi valley, and consequently that the theories of origin for the mound-builders suggested by the presence in the mounds of carvings of supposed foreign animals are without basis;

2°. That a large majority of the carvings, instead of being, as assumed, exact likenesses from nature, possess in reality only the most general resemblance to the birds and animals of the region which they were doubtless intended to represent;

3°. That there is no reason for believing that the masks and sculptures of human faces are more correct likenesses than are the animal carvings;

4°. That the state of art-culture reached by the mound-builders, as illustrated by their carvings, has been greatly overestimated.

Dr. Matthews' paper is of eight pages, and is illustrated with five plates. Mr. Holmes's paper, one of the most important in the volume, is noticed on another page. Mr. Stevenson's papers are also fully illustrated, a number of the plates being colored; and his catalogues are not merely enumerations, but are accompanied by a judicious amount of discussion and comparison, which render them of substantial value. The volume has not only a complete table of contents and a full index, but each paper has a separate table of contents, and list of illustrations.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of natural sciences, Philadelphia.

June 10. — The Rev. Dr. H. C. McCook stated that in November, 1883, he received from Mr. Webster of Illinois two globular nodules of earth, each about the size of a grape, which were thought to be the cocoons of a spider. Similar balls had often been found attached by a slender thread or cord of silk to the under side of fallen boards. Dr. McCook was much puzzled to decide upon the nature of these objects, but, on the whole, believed them to be the work of some hymenopterous insect, and not of a spider. Two ichneumons which emerged from similar cells were determined by Mr. E. T. Cresson to be Pezomachus meabilis Cress. Subsequently Mr. Webster sent other specimens, some of which were opened. They contained silken sacs embedded in the centre of the mud-ball, apparently of spider spinning-work; and within these were fifteen or twenty yellowish eggs, evidently those of a spider. The disjecta membra of two adult spiders taken near the balls, although much broken, enabled him to determine them as drassids (a family of the tube-weavers), and probably of the genus Micaria. These had been found simply near the mud-balls, but the connection between them had not been established. Dr. McCook moistened the cocoons in order to give a natural condition more favorable for the escape of the spiderlings, should they hatch; and on May 30, on opening the box, he found about thirty lively young spiders therein. On the bottom of the box was a dead ichneumon, which had cut its way out of the side of one of the balls by a round hole. The spiderlings seemed to have escaped from their ball along the slight duct left at the point where the bit of silken cord was embedded in hard earth, and thence protruded, forming the cocoon-stalk by which the ball was attached to an under surface. The appearance of the spiderlings indicated that they had been hatched two or three days when first seen. They were evidently drassids of the same species as the broken specimens above alluded to. Thus the interesting habit of concealing her future progeny within a globular cradle of mud was demonstrated to belong to a spider as well as to a wasp. That this particular species is much subject to the attacks of hymenopterous parasites is already proved; but that it is more exposed than many other species which spin silken cocoons, otherwise unprotected in very many localities, does not appear. There is no evidence that so strange a habit has developed from necessity, and none that it proves more protective than the ordinary araneal cocoonery. Dr. McCook had named the species, provisionally, Micaria limnicunae (*limnus*, mud, and *cunae*, a cradle), although it is possible that Hentz may have described the species as one of his genus Herpyllus. The only spider-cocoons known to the speaker, at all resembling those of M. limnicunae, he had collected at Alexandria Bay, N.Y., on the St. Lawrence River, in 1882. They were attached by very close spinning-work to the under side of stones. But the external case, instead of being of mud, was a mass of agglomerated particles of old wood, bark, leaves, blossoms, the shells and wings of insects, etc. These were held together by delicate and sparsely spun filaments of silk. Two of these chip-balls were opened, and found to contain whitish cocoons similar to those in the mud-balls of M. limnicunae. Another had within it the characteristic cell of some hymenopterous parasite containing a dried-up pupa. A very thin

veneering of yellow soil enclosed the silken case, but otherwise no mud was used. On comparing these specimens with those from Illinois, it was believed that they were the work of closely related or perhaps the same species. It is very common for spiders of various and widely separated families to give their cocoons a protective upholstering of scraped bark, old wood, etc., and not unusual to find species that cover their egg-nests wholly or in part with mud; but the speaker was not aware that any species had yet been published as making cocoons like either of the above described forms. He believed, therefore, that the facts were wholly new to science: certainly they were new to the field of American araneology.

June 17. — Referring to the Lycosa, whose weaving of a round cocoon had been the subject of study in the early part of May (see *Science*, iii. 685), Rev. H. C. McCook stated that on June 4 the spider was found with the young hatched, and covering the upper surface of her body. The empty egg-sac still clung to the spinnerets, and the young were grouped over the upper part of the same. The entire brood was tightly packed upon and around each other, the lower layers apparently holding on to the mother's body, and the upper to those beneath. Twenty-four hours afterward the cocoon-case was dropped, and the spiderlings clung to the mother alone. An examination of the cocoon showed that the young had escaped through the thin seam or joint formed by the union of the egg-cover with the circular cushion when the latter was pulled up at the circumference into globular shape. There was no flossy wadding within, as is common with orb-weaving spiders — nothing but the pinkish shells of the escaped young. One week later about one hundred of the spiderlings had abandoned the maternal perch, and were dispersed over the inner surface of the jar, and upon a series of lines stretched from side to side. About half as many more remained upon the mother's back, but by the 13th all had dismounted. Meantime they had increased in size at least one-half, apparently without food. —— Professor Angelo Heilprin exhibited a number of microscopic slides, received from Mr. K. M. Cunningham of Mobile, containing foraminiferous dredging from the Red Snapper Bank, off Mobile harbor, Gulf of Mexico, and preparations of organisms from the rotten limestone of the north-eastern portion of Mississippi, — a rock which represents the inner border of the Gulf during the cretaceous period. The recent forms of foraminifera are interesting as affording material for comparison with those of the ancient sea. There is a remarkable difference in the forms. From the present waters, about eight genera are indicated by the slides in question; Discorbina, Rotalia, Textularia, Cristellaria, and Nodosaria being included among the Perforata. Although Globigerina forms such an important feature of the ooze of the open seas, not a single specimen which could with certainty be referred to this genus was found in the material from the Gulf of Mexico. Textularia was the most abundant form. Among the Imperforata, we have, of the family Miliolidae, a very considerable abundance of Quinqueloculina and Biloculina. In the foraminifera of the limestone the family represented by these genera seems to be entirely absent, and but few of the others are left. Discorbina and Textularia almost make up the entire fauna represented by the specimens received. Even these are of much smaller size than corresponding forms from the Gulf ooze. It is not a little surprising that there should be such a distinction between the organisms of the two periods, in view of the continuous existence of the body of water in which they lived, and of the persistent types which they represent. About twenty-five distinct forms of foraminifera had been determined from the greensand of New Jersey, which is the approximate geological equivalent of the rotten limestone of Mississippi. —— Professor Heilprin also exhibited a specimen of a beautiful little trilobite, Calymene Niagarensis, from the bank of the Yazoo River, above Vicksburg. The formation at the locality indicated is eocene; but, as Silurian beds exist farther up the stream, the presence of the specimens at the point from which they were collected undoubtedly represents a downwash from above.

Botanical section, June 5. — Mr. Thomas Meehan remarked that few botanists would expect to find opposite leaves in Salix; but in S. nigra Marshall they appear at a certain stage of growth, — a fact which has much significance. This species is of that section which has the flowers co-aetaneous with the leaves; that is to say, instead of the aments being sessile, they terminate short branches. They are, however, not absolutely terminal, but appear so by the suppression for a time of the terminal bud. In the case of the female ament, this terminal bud usually starts to grow very soon after the flowers mature, and forms a second growth, when the fertile catkin or raceme of fruit becomes lateral. It is the first pair of leaves on this second growth that is opposite: all the rest are alternate, as in the normal character of the genus. The leaves are so uniformly opposite, under these circumstances, that there must be some general law determining the condition, which has not yet been developed.

Engineers' club, Philadelphia.

June 7. — Mr. William H. Ridgway described a simple crane, consisting of a cylinder hung from the jibs of an ordinary foundry crane, and using the steam directly to hoist the load. —— Mr. C. Henry Roney exhibited specimens of American sectional electric underground conduits as laid in Philadelphia. —— Prof. L. M. Haupt supplemented his paper of May 17, upon rapid transit, by an interesting collection of statistics of the growth of the city from the time of the 'pack-horse' to the present, and showed by maps that his previous statements were verified by these statistics. —— Mr. A. E. Lehman exhibited to the club a model of a new protractor, and described the invention and the improvements he has made in it. It consists of a combination of protractor, T-square, scales, etc., which may be worked separately or together. As a protractor only, it is complete, being

graduated to degrees and fractions thereof, and provided with a vernier reading to three minutes. It can be used, like an ordinary paper or ivory protractor, for hasty plotting, and combines triangles and scales in one instrument. For careful and precise work, it is said to be equal to the best special instrument, and to be no higher in price. —— Mr. E. V. d'Invilliers read a paper on some characteristics and the mode of occurrence of the brown hematite (limonite) ores in central Pennsylvania, taking for his field of illustration the lower Silurian limestone valleys of Centre county. He described the anticlinal structure of these valleys, and the great erosion, aerial and subaerial, which these rocks (six thousand feet thick) have undergone, influencing the position and character of many of the present ore-deposits. He noted three varieties of ore: 1°. The wash and lump hematite of the Barrens; 2°. The true limestone 'pipe ore.'; 3°. An intermediate *transition* variety. The first is always associated with the sandy magnesian beds low down in the series of No. 2, or below five thousand feet beneath the overlying Hudson-River slates of No. 3. This class shows rounded ore and flint balls, and tough, barren clay, and are secondary or derived deposits of irregular shape. They have been tested a hundred feet deep, and contain from 45% to 53% iron, and .051% to .113% phosphorus. The almost total absence of bisulphide of iron is noticeable. The cost of mining is about a dollar and a half per ton. The transition variety was assigned a position in the formation from thirty-five hundred to five thousand feet below the slates. They are characterized by a more calcareous clay, are compact, amorphous, liver-colored ores, containing from 40% to 49% iron, and from .115% to .365% phosphorus. The pipe ores occur usually higher in the limestones than either of the other two, but in this county *below* the four hundred feet of upper Trenton layers. These ores occur *in situ* between parallel walls of limestone, in plate-like masses, scales, or as cylindrical pipes in bunches eight or ten feet long, while feathering out both in line of strike and dip. The deeper banks show the repeated occurrence of crystals of iron pyrites in all stages of metamorphism. They occur at great depths, and show from 45% to 53% iron, and from .100% to .185% phosphorus. The flint or quartz grains accompanying them are rarely water-worn; and this clay is very calcareous and easily washed, not requiring the jigging necessary for cleansing the lower ores. Cost of mining these ores varies from ninety cents to a dollar and a quarter per ton.

New-York microscopical club.

June 6. — Rev. J. L. Zabriskie read a notice of Appendicularia entomophila Peck, a new fungus parasitic on the fly Drosophila nigricornis Loew. The fly, determined by Dr. H. A. Hagen of Cambridge, was noticed at Nyack, N.Y., between the 13th and 31st of March last, infested with the fungus. But infested specimens have not since been found. In the spring of 1880, three specimens of the same fly, similarly infested, were captured at New Baltimore, N.Y. These latter specimens were preserved and mounted; but, from lack of time and opportunity, the true nature of the parasite was not then recognized. The fungus has been submitted to Prof. C. H. Peck, New-York state botanist, who has kindly examined it, and named it Appendicularia entomophila. It is closely related to the Sphaeronemei of the family Coniomycetes. Like Sphaeronema, the fruit has a bulbous conceptacle, surmounted by a long beak perforated at the apex, where the spores ooze out in a globule; but, unlike any described Sphaeronema, this has the conceptacle seated upon the broad summit of a pedicle as long as the conceptacle itself; and also on one side of the summit of the pedicle and at the base of the conceptacle, it has an erect, leaf-like appendage, with strongly serrate margins, like a white-elm leaf folded along its midrib. The spores are slender, pointed at each end, and divided by a septum into two unequal cells, one cell being twice as long as the other. The total length of the fruit is from .02 to .03 of an inch, and that of the spores from .001 to .002 of an inch. The conceptacles of the fungus project directly from different points of the surface of the fly; so that they are found in all positions, — erect, horizontal, and dependent. They grow sometimes singly, but oftener in clusters of two, three, or more, and are found most frequently on the tibiae of the hind-legs, but also springing from the inner posterior surfaces of the abdominal rings, from the costal vein of the wing, from the head, and from the thorax. One of the New-Baltimore flies had about fifty of these conceptacles on various parts of the body and limbs.

NOTES AND NEWS.

DR. GILL has recently paid a visit to the workshop of the Messrs. Repsold, and gives an account of the great Russian telescope, with several particulars not contained in Professor Newcomb's report (*Science*, No. 60). The tube, instead of being cigar-shaped, as in the Washington and Vienna telescopes, is cylindrical, and therefore no larger at the centre than at each end. The object of choosing this form is in order that the centre of gravity of the tube may be as near as possible to the polar axis of the instrument. The central part is of cast-iron. The steel plates diminish in thickness from the centre towards the object-glass, so that the whole structure is extremely rigid. In order to get a sufficient field of view, the micrometer has been made about a foot long. The micrometer contains a small spectroscope, so arranged that the spectrum of any celestial object can be observed without any change of the instrument. It is expected that the telescope will be mounted at Pulkowa during the coming autumn. Some delay, however, has been experienced in getting the dome into working order, and this may still farther delay the mounting of the instrument.

— A memorial tablet, in honor of the late Professor Charles F. Hartt of the geological survey of Brazil, has been placed in the library of Acadia college, Wolfville, N.S. It was here that Professor Hartt

received his collegiate training, and first manifested that interest in the study of nature which became so fully developed, and yielded such good fruit, in after years. The sisters of Professor Hartt were present on the occasion of the unveiling of the tablet, and have presented to the college a fine crayon portrait of their brother, by Black & Co. of Boston.

— It has long been the custom of certain entomologists to form albums of butterflies' wings by pressing the wings on gummed paper. The scales adhere to the paper; but, after they are stripped off, the scales lie with the under side exposed. Milani and Garbini, in the current volume of the *Zoologischer anzeiger* (p. 276), describe the following method of transferring the scales to a second piece of paper, so that they may lie right side up. After the first paper is dry, the second piece is painted with a solution of gutta-percha; the two pieces are then pressed together, and allowed to dry; they are next soaked in water until the gummed paper can be pulled off, and left or washed until all the mucilage is dissolved; the paper with the scales is then dried in the sun. The gutta-percha solution is prepared by soaking five parts gutta-percha, cut very thin, in fifty parts sulphuric ether for twenty-four hours, then adding two hundred parts benzine in which five parts of elemi have been previously dissolved.

— Holmes's 'Art in shell' is an extract from the second annual report of the Bureau of ethnology, shortly to appear. It contains a hundred and twenty-six pages, and fifty-six plates. A small portion of the matter has appeared previously in the second volume of the Washington anthropological society's transactions. Even the present paper is not final, but is to be regarded simply as an outline of the subject, to be followed by a more exhaustive monograph of the 'art in shell' of all the ancient American peoples. The first few pages treat of shells used as implements and utensils, either unchanged by art, or converted into vessels, spoons, knives, scrapers, agricultural implements, fishing appliances, weapons, and tweezers. Much of this matter is familiar; but it is admirably grouped together and illustrated, and new facts are brought to light. Shells were for ornamental purposes converted into pins, beads, pendants, perforated plates, and engraved gorgets. Mr. Holmes studies the beads as to their form in perforated shells, discoidal beads, massive beads, tubular beads, and *runtees;* and as to their uses for ornament, for currency, and for mnemonic purposes. The chapter on wampum will give great pleasure to many readers, but that portion of the paper which treats of engraved gorgets possesses the most absorbing interest. "Many of the gorgets obtained from the mounds and graves of a large district have designs of the most interesting nature engraved upon them." For the purposes of description and illustration, they are presented in the following order: the cross, the scalloped disk, the bird, the spider, the serpent, the human face, the human figure. In addition to the many theories of the origin of the cross symbol, Mr. Holmes suggests the following: "The ancient Mexican pictographic manuscripts abound in representations of trees, conventionalized in such a manner as to represent crosses. By a comparison of these curious trees with the remarkable cross in the Palenque tablet, I have been led to the belief that they must have a common significance and origin." Those familiar with the paper of Dr. Joseph Jones on the antiquities of Tennessee will remember a rosette-like, carved shell, in rough outline resembling a Mexican calendar. Mr. Holmes describes and figures a number of these, believing them to be calendar disks. The bird disks are not very interesting, either in form or variety, although the occurrence of odd forms in widely separated areas will occasion some astonishment. On the contrary, the spider gorgets are both novel and beautiful. If we are not mistaken, it was Col. Hilder of St. Louis who first drew attention to these wonderful objects. Major Powell tells us that the Shoshones regard the spiders as the first weavers, who taught their fathers the art. The wild tribes call the Navajos, spiders. And down in the bottom of a mound, on the breast of a skeleton, lay the disks of the Busycon, on whose concave surfaces were carved the image of this ancestral spinner, bearing the cross symbol on his back. The serpent symbol is a familiar object in aboriginal art, and we are not surprised to find it on shell disks. The remarkable similarity of some of these serpent forms, on disks found in mounds, to the representations of the same animal in Mexican and Central-American antiquities, is barely hinted at by the writer, and dismissed for want of space. The mask gorgets are very rude and uninteresting, but the most astonishing of all are those depicting the human figure. In looking at the drawings, one does not know which to admire more, — the cleverness of the artist in masking his design, or the shrewdness of Mr. Holmes in the interpretation of it. You are asked to look at the image of a man in plate lxxi. You surrender the task as hopeless. The author guides your eye here and there, and you are convinced and delighted. The close examination of the subsequent figures assures you that he is right. We cannot close this brief notice without calling attention to the wonderful unfolding of new problems by the solution of older ones. In the same volume that will contain this paper, by Mr. Holmes, the mound-builders will be severed from Mexico and Central America; but here are new facts to explain, even more perplexing than the old.

— A laboratory for bacterial research has been founded in the Pathological institute of Munich, and the first course of lectures, founded on Dr. Koch's latest methods, has begun.

— Dr. Emmerich, an assistant in the Hygienic institute of Munich, professes to have discovered the cause of an epidemic of inflammation of the lungs, by which a hundred and sixty-one persons were attacked, through discovering the peculiar bacteria of the disease in the plaster of the infected house.

— Mr. Huxley's report of last year's salmon-fishing confirms his own assertion that very little is known about the influences which regulate salmon-supply. The take of salmon and sea-trout has increased and

diminished in defiance of all theories; and Mr. Huxley is equally unable to establish any consistent relation between the take of salmon, and the proportion of grilse present in succeeding years; a large take being sometimes followed by scarcity, and sometimes by abundance of grilse. Mr. Huxley's sympathy with manufacturers has grown with his experience; and, while he acknowledges the importance of the rivers, his confidence in the power of legislation has diminished with experience, but he still insists on the necessity of it. The two points brought out by the continued experiments of Mr. George Murray of the British museum, are, that the fungus may attack fish with whole skins, and otherwise perfectly healthy, and that an excess of lime in the water is not a predisposing cause of the disease.

— The *Popular science monthly* states that Professor John Trowbridge of Harvard university has written a text-book for schools, which D. Appleton & Co. have in preparation. It is entitled 'The new physics,' and admirably carries out the principles of the new education, in requiring the pupil to become familiar with the properties of matter and the phenomena of force by performing experiments for himself.

— A new series of science text-books, each of which is the work of an able specialist, is being brought out by D. Appleton & Co. The 'Physiology,' by Roger S. Tracy, M.D., sanitary inspector of the New-York city health department, and the 'Chemistry,' by Prof. F. W. Clark, chemist of the U. S. geological survey, are now ready. Before Sept. 1, will be issued the 'Zoölogy,' by C. F. Holder, and J. B. Holder, M.D., curator of zoölogy of the American museum of natural history of New York; and the 'Geology,' a new elementary book, by Professor Joseph LeConte of the University of California. Other volumes are to follow soon.

— In his 'Historical account of the Taconic question in geology,' which Dr. T. Sterry Hunt contributes to the recent Transactions of the Royal society of Canada, we find the most complete and systematic of Dr. Hunt's many contributions to this much controverted section of geological history; and even those who do not accept his conclusions must feel grateful for this clear and concise statement of the grounds upon which they rest. The introductory chapter is devoted to an explanation of the classification of the older rocks of eastern North America, proposed by Eaton in 1832, the abandonment of which is regarded as having materially retarded the progress of American geology. The second chapter is a brief history of the geological survey of eastern New York by Emmons and Mather, and an explanation of their divergent opinions concerning the age of the rocks east of the Hudson River and Lake Champlain. Dr. Hunt accepts the name of Ordovician, proposed by Lapworth in 1879, for the rocks called Cambro-Silurian of late years, and including the Chazy, Trenton, Utica, and Hudson-River groups of this country. The older rocks of eastern Pennsylvania are discussed in the third chapter; and the argument for the Taconian or pre-paleozoic age, of the major part at least of the primal, auroral, and matinal of Rogers in the great Appalachian valley, seems to be greatly strengthened by the comparison of the stratigraphy of this valley with that of the Kishacoquillas, Nippenose, and other anticlinal valleys of central Pennsylvania. Typical Potsdam and calciferous are said to be wanting in this state. The gneisses and schists south-east of the great valley are referred to the Laurentian and Montalban systems; and the rocks of South Mountain, to the Arvonian and Huronian. In the fourth chapter, Dr. Hunt traces the distribution of the Taconian system beyond the original areas in Massachusetts, New York, and Pennsylvania, and cites many new facts sustaining his view of its distinctness from the paleozoic above, and the eozoic below. The occurrence of Scolithus and other fossils in the Taconian is asserted; and of especial interest, in this connection, is the discovery by Powell and Walcott in the Grand Cañon of the Colorado, below the base of the Cambrian, of over ten thousand feet of uncrystalline rocks holding Stromatopora-like forms. The next two chapters are devoted to the upper Taconic of Emmons, the Quebec group of Logan, including the Potsdam and calciferous; and the memoir concludes with a general sketch of the paleozoic history of North America.

— Mr. E. J. Maumené has published the result of his investigations into the existence of manganese in wine. In *Cosmos les mondes* for May 17 he gives thirty-one instances in which he detects manganese in the state of a double tartrate of the protoxide of manganese and potash.

— 'The records of the geological survey of India,' part ii., for 1884, contains a note on the earthquake of the 31st of December, 1881, by Mr. R. D. Oldham. This earthquake was felt over a large portion of the Indian peninsula and Bengal, occasioning considerable damage in the Andaman and Nicobar Islands. Mr. Oldham has been enabled to trace the earth-wave with much certainty over a large area, to add considerably to our knowledge of seismic phenomena, and to construct a good map showing the area of disturbance.

— The renewal of the Damoiseau prize by the French academy, for the revision of the theory of the satellites of Jupiter, is announced for the year 1885.

— Dr. Hyades, a member of the French meteorological mission to Cape Horn, attached to it for the purpose of observations on natural history, has published a contribution to Fuegian ethnography, which is interesting as supplementary to the observations of Mr. Bridges, the missionary of the South-American missionary society. Dr. Hyades refers in terms of high appreciation to Mr. Bridges' study of the Galgan language, of which he has compiled a manuscript dictionary, which he has had completely to recast twenty times before bringing it to perfection, and which certainly ought to be published. Some specimens of the vocabulary and of the grammatical struc-

ture of the language are given. The missionaries have succeeded in improving the material condition of the Fuegians, and have induced some of them to adopt agricultural, pastoral, and other industrial pursuits.

— In the current volume of the Proceedings of the American academy, Mr. Arthur Searle publishes an elaborate and exhaustive reduction of all the accessible observations of the zodiacal light. The paper gives the position of the axis of the cone, and the apparent boundaries of the light, as determined by nearly six hundred and fifty different observations by Jones, Heis, Lewis, and others; and tables appended give monthly means and other data which summarize the results in a very complete manner.

Mr. Searle does not indulge in much theoretical discussion as to the nature of the zodiacal light, but he points out that the apparent slight deviation of the axis of the cone from the ecliptic is most probably due to the effect of atmospheric absorption, and calls attention to the necessity of more refined methods of observation. He says, —

"If atmospheric absorption has the importance here assigned to it in the study of the zodiacal light, we cannot expect to determine the true position of the light on any occasion by the simple methods heretofore in use. We must either discover exactly what an observer means by the boundary, and to what extent this boundary will be displaced by given changes of brightness, or we must resort to direct photometric observations. The last course will probably be preferable."

He suggests a modification of the method employed by Wolf in tracing out the nebulosity about the Pleiades, — a method which consisted essentially in watching the visibility of the threads of a reticle, which disappeared whenever the telescope was directed against unilluminated sky.

In this connection he mentions the interesting fact that the Milky Way appears to be about two magnitudes brighter than the mean brightness of the sky; which would mean, of course, that a square degree of the Milky Way gives between five and six times as much light as an average square degree of the rest of the sky.

His only remark as to the theoretical explanation of the zodiacal light is the following: —

"I have merely to remark, with regard to the ordinary meteoric theory, that it gains greatly in simplicity if we dispense with all the imaginary meteoric bodies, or rings, with which it has usually been connected, and retain merely the conception of meteoric dust diffused throughout the solar system. It may be shown mathematically, if we regard the meteoric particles as solids reflecting light irregularly, that an appearance like the zodiacal cone, with an indefinite vertex, would result. On this subject the work of Geelmuyden may be consulted."

We suppose that by 'diffused throughout the solar system,' he means diffused mainly in the plane of the ecliptic. Indeed, it could be shown, that, if we started with an indiscriminate spherical distribution of meteoric dust around the sun, the disturbing action of the planets would ultimately convert it into an approximately discoidal distribution in a plane coincident with the mean plane of their orbits. At any rate, it is not easy to see how an indiscriminate distribution should lead to any thing but a glow-cone with a *vertical* axis.

There can be no question that Mr. Searle has done an important service to science in collecting and editing in so excellent a manner the hitherto scattered observations relating to his subject.

— Dr. Ernst Haeckel of Jena has been elected a member of the Linnean society for his studies of sponges, Medusae, etc.; also Dr. Alexander Kowalevsky of Odessa, for his zoölogical researches, and Dr. S. Schwendener of Berlin, for his studies in cryptogamic botany.

— The twelfth part of Edwards's 'Butterflies of North America' is almost entirely devoted to the polymorphic and wide-spread Lycaena pseudargiolus, two plates with over sixty figures being devoted to it. Such wealth of illustration is exceedingly rare and correspondingly valuable, particularly with the more fleeting and less known early stages. Nineteen colored drawings of the larva alone are given; and in execution the illustrations have never been surpassed in the most expensive and careful iconographs. The next number will complete the second series, and we are glad the author shows no sign of discontinuing his costly undertaking.

— The slight tendency to lateral cutting possessed by rivers, on account of the earth's rotation, and known sometimes as 'von Baer's law,' has had its efficiency denied about as often as it has been granted, by those who have written on the matter; and, when granted, it has been too often admitted only for streams following meridional directions.

Mr. G. K. Gilbert contributes a new element to the discussion of 'the sufficiency of terrestrial rotation for the deflection of streams,' in a paper read to the National academy of sciences in April, and recently published in the *American journal of science*. Taking Ferrel's measure of the deflective force that comes from the earth's rotation, Mr. Gilbert shows, by a remarkably simple consideration, that its value is not so much in throwing the whole stream against its right bank, as in selecting the swifter threads of the current, and carrying them against the bank; and, further, that this action will have especially well marked development in meandering streams, where it will aid the cutting on the meanders of right-hand convexity, and diminish it on those of left-hand convexity. For the Mississippi, the selective tendency thus determined toward the right bank is nearly nine per cent greater than toward the left; but it is not stated that the valley form has been noticeably affected by this preference. On Long Island, however, the form of the valleys is clearly controlled by the earth's turning, as was first suggested by Mr. Elias Lewis some years ago, and recently confirmed by Mr. I. C. Russell.

The article by Mr. Gilbert advances the question not only by properly applying the law to rivers flowing in any direction, but further by giving it a more delicate analysis than it has yet received, with the conclusion that in certain favorable cases the form of a valley may be decidedly influenced by this hidden control. While the result is of interest to physical-geographers, the method of analysis has a wider

importance. The application of mathematics to terrestrial physics has too often been fruitless from dealing with problems in a simplified or idealized form that departs too widely from the complications of natural conditions. This was notably the case with the supposed demonstrations obtained by Hopkins in his geological speculations. It is therefore gratifying to find that the increased value of von Baer's law, now found by Gilbert, comes essentially from a close consideration of the actual rather than of the ideal conditions of river-flow. It is an advance in the application of mathematics as well as in the explanation of facts.

The lateral tendency of rivers was first noticed in the case of the Volga, which undercuts its right bank, as it should in this hemisphere. Other examples are found in North Carolina, in the channels of the streams flowing eastward to the coast, where the southern banks are the steeper; again on Long Island, and on the plains of New Zealand. But the radial valleys of south-western France afford better illustrations than any of these, inasmuch as their forms are accurately shown on the great map of the army engineers. North of the Pyrenees, about the towns of Tarbes and Auch, there is an old sandy delta deposit spread out by the rivers from the mountains while this region was still under water; and since its elevation, the streams formed upon it all follow its gentle slopes, diverging like the ribs of a fan from the higher centre toward the lower margin, and cutting down their channels into the old delta plain. There is nothing here in the flat layers of unconsolidated sands to determine an unsymmetrical form in the valleys: and yet they all show most distinctly a gentle slope on the left, and a steeper slope on the right; longer lateral branches on the left, and shorter ones on the right; and many of the highways, constructed parallel to the streams on the as yet unbroken uplands, are clearly closer to the streams on their left than on their right. All this is a direct effect of the earth's rotation.

It is customary, in speaking of the deflective force that arises from the earth's rotation, to say that it acts to the right in the northern hemisphere, but to the left in the southern. The reason for this is not found in a change in the direction of the force, but only in a change in our way of looking at it. It is as if one should look at the face of a watch in the northern hemisphere, and say that the hands turn to the right, and then, on going to the southern hemisphere, look at the back of the watch, and say that the hands turn to the left. Let us therefore suggest that the geographers of the southern hemisphere look at their winds and storms and streams from the proper side, just as they look at their watches; and, although this would involve them in the slight inconvenience of standing on their heads, it would give them the moral satisfaction of seeing that the deflective forces of the earth's rotation, as well as the hands of their watches, always 'make for the right.'

— Mr. Lockyer has given an account of a recent visit to the observatory at Nice, the building of which is due to the munificence of Mr. Bischoffsheim, the well-known French banker. In connection with this, Mr. Lockyer presents some striking ideas respecting the future of physical observations of the heavenly bodies. He suggests that it is now time to abolish the observer entirely, and that any astronomer would be losing his time by attempting to draw either the nebula of Orion or the spectra of stars. Photography should take the place of hand-drawing for both of these purposes. He pictures an astronomer, one thousand years hence, in a room filled with photographs giving a picture of every part of the heavens, from pole to pole, as it appears to us in the nineteenth century. By using a different form of telescope, the expense of a dome could be avoided. Altogether, Mr. Lockyer's suggestions are well worthy the attention of all engaged in planning observatories.

— In 1885 an exhibition of inventions is to be held at South Kensington under the patronage of the Prince of Wales. The first part of the exhibition is to be of all inventions made or brought into use since 1882; the second part is to be of all musical instruments invented since 1800. The committee of the first exhibition includes many of the most eminent scientific men in England.

— The *Illustrirte zeitung* reports an interesting discovery in the department of photography. Eleven years ago Professor Vogel of Berlin explained a method by which the effects of colors, such as blue and yellow, might remain unchanged as to light and shade, and which would overcome this difficulty of photography. He has now worked out a process on this principle with practical success: it is published in the *Photographischen mittheilungen*, and the German photographic society has awarded him a prize for it.

— Professor Carnoy, of the Catholic university of Bouvain, announces a work on 'Biologie cellulaire,' which will treat of the general characters of cells, both animal and vegetable. He proposes to deal with the general organization, chemistry, and physiology of cells, basing his work upon original observations, either new, or confirmatory of previous researches. He promises over four hundred new illustrations, engraved with great care and accuracy. The scheme is ambitious; but, if well carried out, it will secure us a valuable book on an aspect of biology too little heeded at present. Professor Carnoy is a botanist, whose reputation will rise high if his volume fulfils the promises of the prospectus. It is to be published at Lierre, Belgium, by Joseph Van In & Cie. The price to subscribers is twenty-five francs.

— If an observatory is to be judged by the number of its astronomers and the variety of its work, that of Paris must rank as the first in the world. The most important work now in progress is the construction of the great catalogue of stars observed during the past thirty years, the printing of which has been commenced. The Bischoffsheim circle, known as the 'cercle du jardin,' has thus far been used only for day observations. One of the most important improvements has been the introduction of the shallow amalgamated basin for holding the quicksilver used in the artificial horizon. Very careful experi-

ments have been made to ascertain whether the level of the quicksilver in this basin remains unchanged after any slight motion. To test this, alternate observations were made with the amalgamated and with the ordinary basin. The results show conclusively that the amalgamated basin preserves its level perfectly. Moreover, the disturbance produced by the passage of carriages in the neighboring street is scarcely perceptible, so that it is now possible to observe the nadir at any hour of the day with perfect ease. The result is, that one of the great objections to building an observatory in the neighborhood of a railway is done away with.

— A new observatory has been recently established on a mountain in the south of France, known as Pic de Midi. Here Mr. Thollon has erected his most powerful spectroscope, and reports that he can see daily forty rays of the chromosphere in a region where ordinarily only eight are visible. He also makes the new and interesting observation that the granulations of the photosphere are visible in his spectroscope as fine striae extending through the whole length of the spectrum. What is yet more curious, similar granulations seem to show themselves in the chromosphere, being indicated by the character of the hydrogen lines, which are broken up into small pieces instead of being continuous. It may be remarked, in this connection, that this observatory is not a purely governmental one, but has been constructed with the funds donated by various private individuals and scientific bodies of France.

— The University of the state of Missouri has commenced the issue of a Bulletin of its museum by the publication of a paper on Niagara fossils by Prof. J. W. Spencer, its director. It is mostly devoted to graptolites and Stromatoporidae of this formation, and is illustrated by eight plates, rather rudely executed, but apparently tolerably well drawn.

— The *Academy* announces that Professor Mayor of St. John's college, Cambridge, will be obliged by the communication of any reminiscences of the late Dr. Isaac Todhunter, or of any letters written by him.

— Engineers, manufacturers, and others interested in the progress of mechanical science, and wishing to attend the meetings of the mechanical section of the American association at Philadelphia next September, should send to the secretary (J. B. Webb), at Ithaca, N.Y., for membership blanks, or abstract blanks in case it is their intention to prepare a paper for the meeting.

— It is reported that Prof. C. E. Bessey, of the State agricultural college of Iowa, has been offered a professorship of botany and horticulture at the University of Nebraska.

— We learn from *Engineering*, that Hirn, the French astronomer and physicist, has devised an apparatus for determining the actual calorific power of the solar rays. An alembic of copper containing sulphuric ether is exposed to the sunshine. The heat absorbed volatilizes the liquid, which is condensed in the alembic. Regnault's formula is employed to calculate the solar heat absorbed from the quantity of liquid condensed.

— According to the tables recently published by the Direction générale des contributions indirectes, the total production of alcohols in 1883 amounted to 2,011,016 hectolitres. This is an increase of 244,450 hectolitres over the year 1882, and 508,439 hectolitres more than the mean of the last ten years. This increase is due in great part to the advance made in the manufacture of spirituous liquors by the distillation of farinaceous substances.

— The fifth annual report of the museum of the Ohio Wesleyan university states that the additions during the year amounted to seventeen hundred and ninety. The need of more shelf-room is much felt.

— Dr. H. Ploss, whose well-known work, 'Das kind in brauch und sitte der völker,' appeared last year in its second edition, announces for immediate publication, in parts, 'Das weib in der na ur- und völkerkunde.' The prospectus states that it will treat of the natural history of woman, principally from an anthropological stand-point, and as it appears to the naturalist and sociologist. The work is to be published at Leipzig, by Grieben, in eight lieferungen: price two marks each. When complete, they will form two volumes, 8vo.

— There are now twenty-three countries with a total population of 241,973,011, in which the metric system of weights and measures is the legal standard; four (Canada, Great Britain, United States, and Persia) with a population of 97,639,825, in which the system may be used; and six, including Russia and British India, with a population of 333,266,386, in which the system has no legal standing.

— The report of the North Carolina agricultural experiment-station for 1883 is almost wholly devoted to commercial fertilizers; although a few analyses of fodders are reported, and more or less work is mentioned as having been done for the state geologist and the state board of health which is not reported here. The most generally interesting portion of the report is that concerning the recently explored deposits of phosphatic nodules and rock in the state, some account of which has already been given by Dr. Dabney in *Science*, iii. 31.

— A convention of agricultural chemists, which met in Atlanta, Ga., May 15 and 16, appointed Prof. S. W. Johnson of Connecticut, Prof. H. C. White of Georgia, and Prof. W. C. Stubbs of Alabama, a committee to propose a method for the determination of phosphoric acid in fertilizers. Their report, which is too long for reproduction here, recommends a method for general use for the twelve months following its date, and promises further investigation and a report at a future time. It was resolved by the convention, "that this method be not considered as binding upon any one, but that the convention recommends it to the profession, and hopes that all not bound by conflicting obligations will follow it."

SCIENCE.

FRIDAY, JULY 11, 1884.

COMMENT AND CRITICISM.

THE increasing number of international scientific congresses whose function is the establishment of common points of departure, and the unification of standards of measure both as to dimensions and nomenclature, is a hopeful sign of progress towards the 'millennium' to which men of science are unquestionably nearer than their political brethren. It is delightful to find that there are so many important matters concerning which scientific men representing many nations and many languages find themselves in perfect agreement. Although in many instances a surrender of some personal or patriotic claims has been demanded, this has been generally acceded to with little protest, to the end that universal advantage may be the outcome. When work of this kind is done, it should be done for all time to come; at least, what is definitely fixed upon should be of such a nature that it will not need undoing in the near future.

In this respect the report of the electrical congress is something of a disappointment. The congress seems to have reached its conclusions in undue haste. Indeed, the electrical units as now defined are less precise and scientific than before. The reference of the practical units to those of the C. G. S. system was in itself admirable and satisfactory. With the new definitions, one only, that of current strength, has a precise relation to the fundamental units: the others have become arbitrary. Would it not have been better to adhere to the original ohm, and to define the mercury unit as provisional? The new mercury unit is obtained from measurements that differ among themselves by more than two per cent. Besides, the verdict was made up before the results of Professor Rowland's exhaustive investigation, now in process, were in the possession of the congress, although this investigation was admitted to be one of the most important. A provisional mercury unit of a hundred and six centimetres would have satisfied all practical demands, and would have been subject to such correction as future research indicated to be necessary. As the matter now stands, the elegance and simplicity of the system is destroyed by the introduction of arbitrary units, the value of which may some time be found to be considerably different from that now assumed.

While the congress might have acted more wisely in the opinion of many, in the matter of the ohm, in its definition of the standard of light it would certainly have done well to postpone action for the present. It appears, that, because nothing better was offered, the square centimetre of fused platinum was adopted. Although this is a matter which is greatly in need of adjustment, there can be little satisfaction in the adoption of what is, as nearly as may be, an impossible standard. There must have been a paucity of suggestions as to a suitable standard; which is singular, considering the prominence of the problem of measuring intense lights. And in recommending that all records of observations of atmospheric electricity and earth-currents should be sent to the international bureau at Berne, the congress simply acknowledged our present ignorance.

BIBLIOGRAPHIES of special authors have but an ephemeral value, if made during the life, or at least during the activity, of a writer. It would therefore, in our judgment, have been better to restrict the one just issued by the National museum, and fully described in our notes, to Professor Baird's direct contributions to science, which have avowedly ceased, and

to postpone mention of those undertaken with the assistance of many collaborators (which record the advance of science through the researches of others), or dealing primarily with applied science. However important this latter work may have been, — and we should be far from underrating its importance, especially in the development of science in America, — it not only hinders a proper retrospect, an independent *coup d'oeil*, of his remarkably extensive and valuable contributions to the vertebrate zoölogy of North America, but it seems to demand, at some future time, a repetition of this work, with its almost painful detail and voluminous indexes. The first was the only pressing need: for the other, we could have contented ourselves for the present with the indexes of the everywhere procurable annual records, Smithsonian reports, and fish-commission publications.

A scientific friend, himself a bibliographer, does not look with complacency upon the announcement that similar bibliographies will be given of other still living naturalists. He asks whether those directing or engaged upon this work could not turn their bibliographic energies to better account in another direction. Fathers of a broad science, or pioneers in a vast field, who cover that field, are few indeed; and only their bibliographies, when carried out with the fulness of that which furnishes us our text, can have any possible permanent, or even great temporary, value. What are really wanted are topical and geographical bibliographies, which shall lighten the labor of the expert, and lessen the chances of incorrect statement, and, above all, of unnecessary re-statement. These are the true aids to progress for a generation burdened with a literature vast, ill-assorted, inchoate. Individual bibliographies do not penetrate its depths. Let our zealous bibliographers devote to such work the same time and pains they would give to that proposed, and the result will be of tenfold immediate value, and it will have at least some lasting worth.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The zero meridian of longitude.

In arranging meridians for perpetual usefulness and the best practical results, the location of the 180th degree is of far more importance than that of zero or any other.

When we meet a ship of another nation at sea, we determine upon speaking, one of the most important objects of which is to compare longitudes. We do exchange longitudes, but on comparison we find a large difference between them. Then the question arises, Is one of our chronometers wrong, or are we mistaken as to the meridian from which the other ship reckons her longitude? This ship, by this time, is beyond the reach of our further inquiry, and hence the question cannot be satisfactorily answered. We are in more doubt than before speaking, confusion has been worse confounded, and only because we do not know positively the other's zero meridian. Among merchant shipping, on long voyages, just this sort of trouble occurs constantly, perhaps daily, to the great enhancement of risk to the safety of ships, cargoes, and crews.

Again: an English or an American ship is in mid-Pacific, steering east; crosses the 180th degree of her reckoning, from Greenwich; and then meets a French ship standing west, which has crossed the 180th degree from Paris. They speak, and each asks the other to report him at Lloyds. They arrive in their respective ports, and each reports the other, as requested: but one report states that the speaking occurred on one day, say Monday, the 1st of a month; and the other on another day, say Tuesday, the 2d of the same month. But I will not multiply instances. These two will give some idea, though faintly, of the risk to property and life, as well as the confusion of dates, caused by the present unsettled condition of meridians.

If the 180th meridian were universally recognized as passing through Bering Strait, it could be so projected as to pass clear, or nearly so, of all land throughout its entire length; and, this being true, it could be made the dividing-line of days, naturally and properly, with the greatest possible advantage to everbody everywhere.

If a meridian passing through Bering Strait were adopted as the 180th, then the zero meridian would pass through central Europe, and enter Africa near Tunis, and the Atlantic Ocean from the coast of Guinea, thereby giving Norway, Denmark, Germany, Austria, Switzerland, and Italy the opportunity of having their national observatories upon it, on their own soil. C. BORUM.

Norfolk, Va., June 5.

Crystallization of glucose in honey.

A gentleman of our city who is engaged extensively in bee-culture has furnished me with the following rather remarkable incident: —

On opening a cap of honey that had been made subsequent to July 1 of last year, it was discovered that the entire bottom was covered with a layer of some peculiar white powdery substance never before observed. Such an occurrence being new to him, he conferred with some of his acquaintances, also engaged in bee-raising, but with the uniform result of furnishing each with a bit of news. A sample of the white substance was submitted to me, and on exami-

nation was proved to be, with the exception of slight extraneous matter, almost perfectly pure glucose.

The presence of glucose in honey is well known; but a crystallization or separation such as here described appears unknown, in this district at least, and possibly in others as well. Therefore it is that I deem this of sufficient moment to lay before your readers. A few other facts are pertinent. The bees in whose hive the glucose was found have never been artificially fed, nor has any special attention been paid to promote an increase in the yield of honey. Nevertheless, the yield from the hive containing the powder has exceeded, by almost three times, that of any previous year. A sample of the honey will be furnished me, when I propose determining the relative quantity of glucose contained in it, thinking that by that means some light may be thrown on this apparently unique occurrence. SIMON FLEXNER.

Louisville, June 18.

[All honey contains glucose and cellulose in about equal proportions. It is not uncommon for honey to granulate or crystallize in the comb. This crystallization often occurs when the cells are but partly full of honey, so that the granulated sugar only occupies a part of the cell. If such combs are placed in a hive, the bees will add honey, and produce the phenomenon noticed, and described above. There is nothing remarkable or very exceptional in this occurrence, though it occurs so rarely that it is not strange that most apiarists have failed to observe it. — ED.]

North-eastern and north-western Indian implements.

In reply to a note contained in *Science*, iii. 701, I beg leave to explain that Dr. Abbott misapprehends the object of the paper there discussed, my point of view therein having been that of an observer simply, not that of a critic. The particular puk-gah-mah-gun in question received description and illustration in virtue of the definite facts, that it represents the stone age of the north-west, that it is a well finished and mounted typical weapon, that it is of known tribal origin and of ascertained uses, and that, finally, it has an interesting and assured history. If my brief notice of this weapon ignored the diversity of figure found among objects of the war-club pattern, it was partly because I had undertaken to present my notes in a condensed form, and partly, also, because I believed such modification of common type generally understood by those who would be likely to honor me with a reading. I venture in this place to append one or two statements which may, perhaps, have the effect to place matters in a clear light.

The Ojibwas of Red Lake originally descended thither from Rainy Lake, their primary point of departure having been the 'Great Ojibwa,' or Lake Superior, where their tribe claims to have been centralized for ages. The Red-Lakers agree that they effected settlement here about a century ago, after a desperate struggle of long duration with the Sioux, who then inhabited the region; and they impute their eventual success, not so much to superior prowess, as to the fact that the Ojibwas fought with weapons procured from French traders at the north, while the more isolated Sioux were restricted to war implements of their own manufacture. The Red Lake band continued in the stone age, so far as their domestic furnishings were concerned, long after they had discarded their tribal weapons of stone and bone. As they are by no means addicted to nice culinary distinctions, it occurred to me, in the course of investigation, that the bone-breakers, being adapted to deal an effective blow, might, at the early day preceding contact with white traders, have served their owners the double purpose of utensil and weapon; that, in short, the objects used only within historic times for breaking up the bones of game might likewise have been employed prior to such time in dealings with their foe. This conjecture determined the particular line of inquiry which I followed in questioning the natives, and which was without positive results always. The matter would be unworthy of mention here, except for the purpose of correcting a misconstruction. FRANC E. BABBITT.

What's in a name?

It is a pleasant diversion to note the correspondences between people's names and occupations. Here, for instance, are the Meisels, German lithographers; and *meissel* is the German word for chisel, a cutting instrument. Wagner, the inventor of the palace-car, learned the wagon-maker's trade, and subsequently built his railroad-wagon; while his rival, George Pullman, justifies his name by pulling his fellow-men about the world in very sumptuous railroad-coaches.

Turning to the New-York directory, you see, that, out of the 204 Wagners there set down, 10 are in some way concerned with the making or sale of wagons. Out of 132 Carpenters, 17 are either carpenters or builders, or dealers in wagon-materials. Of 1,174 Schmids, Smidts, Schmiedes, Schmidts, Schmitts, and Smiths in New York, 202 are men who use edged tools for the cutting of wood or iron, including blacksmiths, goldsmiths, cabinet-makers, carpenters, etc.: a large number, not included in the 202, are shoemakers and tailors; but these can hardly be called smiths or artificers.

In the Boston directory, out of 336 Clarks (only a small fraction of the whole), 63 are either store-clerks or religious clerics, or engaged in pen-work of some kind. There are 420 Schneiders (or cutters) in New York, and 29 of them are tailors; but of the 91 Sneiders, Sniders, and Snyders, there is not one tailor, and only two cutters of any sort; namely, a cap-maker and a dressmaker. It would seem that the Sniders, in mixing English blood with their own, and trying new fortunes in foreign lands, had got farther away from the instincts of the original trade that gave their German ancestors their name. It certainly seems that it is safe, looking at the data given, to assume that the hereditary tendencies denoted by the name are in many cases marvellously persistent. I have no doubt, that, notwithstanding the continual mingling of new blood (by marriage) with that of each class of tradesmen, we should yet find, if we could know the bent of mind of all members of the class, that the ancestral preferences and aptitudes exist in some degree in each and all. It is to be remembered, that, in the case of such names as Carpenter and Schneider, there would be a more or less strong disinclination for the owners to engage respectively in carpentry and tailoring, owing to the dislike of having to endure the lifelong punning on their names.

All that can be shown is, that, in the case of a certain number (say, one-sixth) of the members of a family or clan, the ancestral occupation reveals its pristine attraction. But the exceptions are notable. Thackeray's ancestors, according to Bardsley, were thatchers (thack, thatch, hence the thacker, and the last modified into the thackery, the thackeray, i.e., the thatcher). Shakeshaft, Shakspeare, Breakspear, from their prowess in battle; Spencer, he who has charge of the spence, or buttery; Whittier, from

white-tawier (the verb 'to taw' meaning to dress the lighter skins of goats and kids, and then whiten them for the glover's use); Stoddard, the stot-herd, or bullock-herd, or herdsman; Palfrey, the farmer who rides his palfrey to market, — here, in the case of well-known persons, we have instances of wide departure of descendants from the trade of their ancestors. W. S. KENNEDY.

A muskrat with a round tail.

It has generally been considered that the compressed, rudder-like tail, and large webbed hind-feet and bent toes, of the muskrat, form its essential distinguishing peculiarities: my surprise was therefore great to find among some specimens recently received from Mr. William Wittfeld of Georgiana, Fla., an animal, which, though resembling an ordinary muskrat in general appearance, possessed neither of these characteristics. It looked, indeed, like an overgrown and dropsical house-rat, and was at first entered in the catalogue by my assistant as a doubtful species of that genus. Its form also suggested that of a pouched rat (Thomomys), but unfortunately there were no pouches. An examination of the skull at once dismissed these erroneous notions, and revealed the true character of the animal. It is, without doubt, a living link binding the muskrat we know so well with the field-mouse. In size it stands between the two. Its eyes, ears, and fore-feet are those of a muskrat; but its tail and hind-feet are those of a field-mouse. I have not yet received any particulars regarding the habits of this Floridan muskrat; but the slight webbing of its toes, and their unbent condition, taken together with the rounded tail, would lead one to prophesy that it is not so thoroughly aquatic as the ordinary muskrat, probably not more so than many of the field-mice.

The ordinary muskrat has never been found in southern Florida, and it is now apparent that its place is supplied by this little relative. I may go aside to say that Florida probably still holds in its southern interior a number of creatures which the eye of science hath not seen, and which will modify the notions we have regarding those already known. As this is the scientific birth of this interesting little mammal, it is necessary that it should be given a name: I therefore christen it with the name of my friend, Mr. J. A. Allen, whose monographs of the North-American mammals are so well known and so highly esteemed; and it shall hereafter be known as Neofiber Alleni. I may, perhaps, be permitted to conclude by summing up briefly the characters of the species, in order that there may be no mistake regarding the appearance of the animal.

Neofiber Alleni. — General form and color, head, eyes, ears, and fore-legs as in F. zibethicus. Hind-feet not exceeding twice the fore-feet in length, with straight, slightly webbed toes, and naked soles. Tail round, scaled, and sparsely covered with dull-brown hairs. Length of head and body, 20.2 centimetres; tail, 12.7 centimetres; hind-foot (without claws), 3.9 centimetres. FREDERICK W. TRUE.

U. S. national museum, Washington,
June 30.

Fish-remains in the North-American Silurian rocks.

The English Ludlow Rocks have long been known as the lowest horizon from which undoubted remains of fish have been obtained. The 'bone-bed' of this group has yielded several species. The earliest known American fossil fish occur in the lower Devonian beds of Ohio (corniferous) and in the Gaspé sandstones of the Gulf of St. Lawrence.

But some fossils have, during the past year, come into my possession, a glance at which is suggestive of near relationship to the peculiar forms of the English Ludlow Rocks. Close examination has confirmed this opinion, and abundantly proved that fish existed on this continent as early as in England. Indeed, should the whole evidence I have obtained be equally valid, it will sustain the conclusion that we have here more ancient ichthyic forms than any yet known elsewhere.

I have entered a paper on the subject for the approaching meeting of the British association at Montreal, when the facts on which these conclusions rest will be given in detail. E. W. CLAYPOLE.

Buchtel college, Akron, O., July 2.

Babirussa tusks from an Indian grave in British Columbia.

Many curious and unlooked-for objects are frequently found in Indian graves, and not least among these is a pair of the tusks of the Babirussa. They were extracted in August of last year by Mr. James S. Swan from the grave of an old Indian doctor at Kah-te-lay-juk-te-wos Point, near the north-western end of Graham Island, one of the Queen Charlotte Islands, off the coast of British Columbia. The Babirussa, as every one knows, is an animal of the hog tribe, inhabiting only Celebes and the adjacent islands. The question then arises, How did these teeth come into the possession of the Indian doctor, who died some fifty years since at an advanced age?

Mr. Swan suggests an ingenious and plausible solution of the problem. In his letter of the 4th of January to Professor Baird, he writes as follows: "Lieut. Bolles, of the U. S. surveying schooner Ernest, tells me that the Siamese junks make regular trading-voyages to the coast of Africa, even as far as the Cape of Good Hope, running down with the north-east monsoons, and returning when the favorable monsoon blows. They bring products of every kind, and trade with Japan and China. He thinks that some of these junks may have been wrecked, and carried by the Japanese current to the American side, and perhaps cast ashore on the west coast of the Queen Charlotte Islands, where quantities of drift-stuff of every kind is to be found.

"Charles Wolcott Brooks, in his able report on Japanese vessels wrecked in the North Pacific Ocean, read before the Californian academy of sciences, March 1, 1876, says, 'Every junk found adrift or stranded on the coast of North America, or on the Hawaiian or adjacent islands, has, on examination, proved to be Japanese, and no single instance of any Chinese vessel has ever been reported.'

"One of these junks was wrecked on the Queen Charlotte Islands in 1831, and numerous others have been wrecked on other parts of the north-west coast. The tusks of the Babirussa were undoubtedly an article of commerce among a people who would be likely to use them for carving or for manufacturing into fancy articles, and it is not improbable that the tusks in question were procured from some one of these old Japanese wrecks."

It is difficult to conceive of another origin for these tusks. The commerce of California fifty years ago was of a very limited character, and Babirussa tusks are among the objects least likely to have been sent there through any regular channel. F. W. TRUE.

U. S. national museum, Washington, D.C.,
July 3.

SPECIALIZATION IN SCIENTIFIC STUDY.

There once was a science called 'natural philosophy,' which, like some old synthetic types of animals, held in itself all the learning that applied to physical facts. By the beginning of this century this science of natural things had become divided into physics and natural history. These divisions have since spread, like the divisions of a polyp community, until now natural history has more than a dozen named branches; and in physics the divisions are almost as numerous. There are now at least thirty named and bounded sciences; each name designating a particularly limited field, in which there are able men who work their days out in labor that does not consider the rest of nature as having any relation to their work.

This progressive division of labor follows a natural law: and it is perhaps fit that science should itself give a capital illustration of the application of this law to forms of thought, as well as to the more concrete things of the world; but it is an open question whether or no it is advantageous to the best interests of learning. There can be no question that the search for truth of a certain quality is very greatly helped by this principle of divided labor. If a man wish to get the most measurable yield out of the earth in any way, the best thing for him is to stake off a very small claim, tie himself down to it, fertilize it highly, till it incessantly, and forget that there are blossoms or fruit beyond his particular patch; for any moment of consciousness of such impracticable things as grow beyond his field is sure to find its expression when he comes to dig his crop, whether his crop in the intellectual field be elements or animals, stars or animalculae. The harvest of things unknown is most easily won in this kitchen-gardening way of work.

The world needs, or fancies that it needs, this kind of work; and it is now of a mind to pay more of its various rewards for the least bit of special and peculiar knowledge than for the widest command of varied learning. In a thousand ways it says to its students, not only as of old, "Study what you most affect," but, "*Effect that study altogether*, know the least thing that can be known as no one else knows it, and leave the universe to look after itself."

This is the prescription of our time. We are now proceeding on the unexpressed theory, that, because no man can command the details of all science, therefore he shall know only that which he can know in the utmost detail. We seem to be assuming, that, if many separate men each know some bit of the knowable, man in general will in a way know it all; that when, in another hundred years of this specialization, we have science divided into a thousand little hermit-cells, each tenanted by an intellectual recluse, we shall have completed our system of scientific culture. No one can be so blind to the true purposes of learning as to accept this condition of things as the ideal of scientific labor. It may be the order of conquest, the shape in which the battle against the unknown has to be fought; but beyond it must lie some broader disposition of scientific life, — some order in which the treasures of science, won by grim struggle in the wilderness of things unknown, may yield their profit to man.

The questions may fairly be asked, whether we have not already won enough knowledge from nature for us to return, in part, to the older and broader ideal of learning; whether we may not profitably turn away a part of the talent and genius which go to the work of discovery to the wider task of comprehension; whether we may not again set the life of a Humboldt along with the life of a Pasteur, as equally fit goals for the student of nature.

Until we set about the system of general culture in science, it will be nearly impossible to have any proper use of its resources in education. A sound theory of general culture in science must be preceded by a careful discussion of the mind-widening power of its several lines of thought. This determination cannot be made by men versed only in their own specialties: it must be made by many efforts to determine by comparison what part of the sciences have the most important power of mind-

developing. At present there are few men whose opinion on such a subject is worth any thing, and the number constantly grows less.

The greatest difficulty partly expresses itself in, and partly arises from, the multiplication of societies which include specialists as members, and specialties as the subjects of their discussions. We no longer have much life in the old academies, where men of diverse learning once sought to give and receive the most varied teaching. The geologists herd apart from the zoölogists: and in zoölogy the entomologists have a kingdom to themselves; so have the ornithologists, the ichthyologists, and other students. 'That is not my department,' is an excuse for almost entire ignorance of any but one narrow field. If naturalists would recognize this 'pigeon-holing,' not only of their work, but of their interests, as an evil, we might hope to see a betterment. Until they come to see how much is denied them in this shutting-out of the broad view of nature, there is no hope of any change. Special societies will multiply; men of this sort of learning will understand their problems less and less well; until all science will be '*caviare* to the general,' even when the general includes nearly all others beyond the dozen experts in the particular line of research.

The best remedy for this narrowing of the scientific motive would be for each man of science deliberately to devote himself, not to one, but to two ideals; i.e., thorough individual work in some one field, and sound comprehension of the work of his fellows in the wide domain of learning, — not all learning, of course, for life and labor have limits, but of selected fields. In such a system there will be one society-life meant for the promotion of special research, and another meant for the broader and equally commendable work of general comprehension.

It is in a certain way unfortunate that investigation is to a great extent passing out of the hands of teachers. This, too, is a part of the subdivision work; but it is in its general effects the most unhappy part of it. As long as the investigator is a teacher, he is sure to be kept on a wider field than when he becomes a solitary special worker in one department.

The efforts now being made for the endowment of research will, if successful, lead to a still further tendency to limit the fields of scientific labor. A better project would be to keep that connection between inquiry and exposition from which science has had so much profit in by-gone times.

HIBERNATION OF THE LOWER VERTEBRATES.

IN a recent article in *Science*, I gave the details of a series of observations of the habit of hibernation as it occurs among our mammals, and endeavored to show that this habit was not so fixed and regular as is commonly supposed.

When we come to study, in their native haunts, our reptiles and other lower vertebrates, it will be found that the same is true of them also. For instance: the turtles, as a class, are supposed to hibernate; but this is not strictly true of all of them. There are nine species of these animals, more or less abundant, in my neighborhood. One, the common box-tortoise, is strictly terrene; while the others are either aquatic or semi-aquatic. The box-tortoise more regularly and systematically hibernates than do any of the aquatic species. After two or three hard frosts, it burrows quite deeply into the earth, and seldom quits its hiding-place until every vestige of winter has disappeared. The appearance of the box-tortoise is the best 'sign' of settled spring weather that I know, though it sometimes fails; but to assert that "tortoises creep deep into the ground, so as to completely conceal themselves from view when a severe winter is to follow," and that "they go down just far enough to protect the opening of their shells"[1] when it is to be mild, is nonsense. The water and mud turtles, of which I have carefully studied eight species, appear, on the approach of cold weather, to bury themselves deeply in the mud at the bottoms of ponds and streams, and to remain there until spring. This is the common impression; and a superficial glance at their haunts during the winter seems confirmatory of it. Is it, however, strictly true of these turtles? The habit of hibernating is at least affected very materially by the severity of the winter. Furthermore, in most ponds of any considerable extent, frequented by turtles, there are sure to be one or more deep holes wherein many of the

[1] Signal-service notes, No. ix.: Weather-proverbs. 1883.

turtles take refuge after the first hard or plant-killing frost. There they remain in the deeper and warmer water, when the shallower portions of the pond are coated with ice. Do they lie in the mud, in these holes, in a torpid condition?

Throughout the winter I have found that many of our fish also congregate in these same deep holes, and the turtles prey to a certain extent upon them; the snapping-turtles (Chelydra serpentina) occasionally catching one, and the other turtles feeding upon the remains of the snapper's feast. What first gave me this impression was the fact, that even in midwinter, in nets set under the ice, I frequently found fishes that had been partially eaten; and, as this also occurs in summer, I took it for granted that the offender was the same in each case. Led by this inference, I baited hooks, and placed them in the deep holes of a large pond, and in several instances succeeded in catching specimens of the stinking or musk turtle (Ozotheca odorata) and of the mud-turtle (Cinosternum pennsylvanicum). In the same way snapping-turtles have been caught, during the severest cold weather, in deep holes, and about large springs that discharge their waters on level ground. It would seem, therefore, that, if the water remains above the freezing-point, these turtles can remain in a fairly active state, even though they do not find any large amount of food. In such spring-holes the grass remains green throughout winter; a few frogs linger in the waters; an occasional bittern haunts the spot; pike, too, are not unusual; and the snapper, therefore, has company at least, and occasionally he makes a meal of some one of the hardy visitors, which, like himself, brave the winter, and do not seek to avoid its rigors by a protracted torpid sleep. As I have not found specimens of each of the aquatic and mud turtles under such circumstances, it may be that some of them are less hardy, and do regularly hibernate for some six months of each year; and, again, it is certain that the species mentioned as active during the winter, do also, under certain conditions, regularly hibernate. The most, therefore, that can be claimed from my observations, is, that the habit, in some species, if not all, is under the control of the animal, and that its exercise is optional.

Snakes, I find, are by far the most sensitive to cold of all our animals, and avoid exposure to it by every available means. Certain of them, when hibernating, are stiff, cold, and unyielding, their condition more nearly resembling death than that of other animals under like conditions. Still we see a difference in the conditions when we compare the habit as exercised by different species. The water-snakes hibernate quite differently from upland snakes. The former seek refuge from the cold in mud beneath water: the latter burrow into dry earth. The former, when disturbed, or on exposure to the atmosphere, 'come to' almost immediately: the latter may be literally broken into pieces without giving evidence of life. By 'water-snakes' I mean, not one or two species of Tropidonotus, that are strictly aquatic, but the several garter-snakes (Eutaenia), and all those that readily take to the water when pursued, as distinguished from the terrestrial species proper, such as the black snake, adder, calico-snake, and others. Indeed, I have sometimes wondered if the true water-snake (Tropidonotus sipedon) really hibernates at all. By dipping a foot or two beneath the sand of any spring-hole, we can usually find one or more of these snakes; and, though somewhat sluggish in their movements, they are not slow to swim off when released, however cold the water may be. I have

CHELYDRA SERPENTINA (ONE-HALF NATURAL SIZE).

noticed, further, that this species and the common garter-snake (Eutaenia sirtalis) are

HYLA VERSICOLOR (NATURAL SIZE).

the first to re-appear in the spring; and, of all our serpents, these sleep least profoundly.

Passing now to the batrachians, my observations upon the hibernation of the turtles applies equally to the frogs and salamanders. The toads and tree-toads, terrestrial and arboreal animals, are more sensitive to a low temperature than the frogs and salamanders, and therefore disappear quite promptly after a few frosts in autumn, and are seldom seen again until the weather is uniformly mild. On the other hand, this does not hold with the aquatic batrachians. When the ice begins to form along the edges of the ponds, and hoar-frost has wilted the grass, frogs and salamanders withdraw to the deeper and warmer waters, — the former to the bottoms of ponds and deep ditches; the latter to the uniform temperature of the springs, and its adjacent mud. They do not, at this time, enter directly into a torpid condition. They appear, rather, to be sleeping lightly, and, when disturbed, respond by hopping or running off, as the case may be. Of course, the warm spots about bubbling springs soon become crowded, and hibernation proper is the only alternative; but those that can retain their positions in such springs quietly remain from autumn until spring, sleeping, it may be, but never becoming torpid. During the winter I have found all of our frogs, and three species of salamanders, congregated in a hogshead sunk in the ground to collect the waters of a spring. Here I have watched them closely during the winter months; and the only variation from their ordinary habits of the rest of the year was, that they kept close to the bottom of the hogshead, and seldom voluntarily moved about. All their functions were, of course, very sluggish; and life was sustained by skin respiration, as with the turtles under like circumstances.

It is scarcely necessary to pursue this subject further. What has already been said of the aquatic reptiles and batrachians is applicable to fishes. To a certain extent, these hibernate in the true sense of the term; but it is the exception rather than the rule. The first evidence of a change is seen in the withdrawal from their usual haunts as the water becomes chilled; but, if we follow this movement, it will be found to be a change from shallow to deep waters; and, unless the cold is very intense, a further change from deep water to mud is not adopted. A remarkable feature of the hibernation of fishes consists in the fact, that, while many individuals of a given species

RANA SYLVATICA (NATURAL SIZE).

may sometimes be found lying in the mud in a torpid condition, others of the same species,

frequenting the same stream, may simply congregate about some bubbling spring, that, issuing from the bed of the pond or creek, tempers the surrounding waters, and renders it habitable during the severest weather. This, it seems to me, is a marked instance of the exercise of choice on the part of fishes, and has an important bearing on the question of their intelligence; and it is, furthermore, corroborative of the statement, made at the commencement of our former article, that hibernation is a faculty which many animals possess, the exercise of which is largely, if not wholly, optional.

CHARLES C. ABBOTT, M.D.

TAIT'S HEAT.

Heat. By P. G. TAIT. London, *Macmillan*, 1884. 368 p. 8°.

THE author says in his preface, "Clerk Maxwell's work is on the theory of heat, and is specially fitted for the study; that of Stewart is rather for the physical laboratory: so that there still remains an opening for a work suited to the lecture-room."

The book before us is the best text-book for a student who is beginning the study of heat that we have seen. The author begins by giving the reader a good idea of force and energy, of the nature of heat, and of the difference between heat and temperature. Heat is a form of energy: temperature must at first be looked on "as a mere condition which determines which of two bodies, put in contact, shall part with heat to the other."

We do not, however, think that a student can get a clear idea of the second law of thermodynamics, and of absolute temperature, from the brief sketch given in chap. iv. In order to have confidence in the deductions from Carnot's cycle, a much more thorough study of thermodynamics is necessary. Chap. xi., on thermoelectricity, contains a very good account of the theory and of the experimental part of the subject. The results of Tait's experiments upon the form of the thermo-electric lines at high temperatures are given, and also a table of the calculated specific heats of electricity for many metals.

The chapter upon combination and dissociation, showing the application of the two laws of thermo-dynamics to chemical combination, is valuable, as such a discussion is not often to be found in text-books.

This book is not everywhere easy reading. Though by far the greater part can be understood by a student who has no knowledge of differential calculus, yet there are certain parts — as in the application of Fourier's method to determine the temperature of the earth's crust, and in chap. xxi., on the elements of thermodynamics — where a knowledge of calculus is necessary.

MERRIMAN'S METHOD OF LEAST SQUARES.

A text-book on the method of least squares. By MANSFIELD MERRIMAN. New York, *Wiley*, 1884. 8+194 p. 8°.

THIS author published his Elements of the method of least squares in 1877. It was favorably received; and, the edition having been exhausted, the work has been now recast, and republished under the above title. In the original work the author attempted, in the first part, to explain the method, and its application to the combination of observations, and, in the second part, to establish analytically the mathematical principles of the subject. In the present work the principles are first developed, and the applications follow: this order of arrangement must, on the whole, be better than the other. The endeavor to have the reader become practically acquainted with the subject before he makes any extended analytical study of it, may possibly enable the student who is somewhat deficient in his mathematical training to obtain a command of the method when otherwise it would be beyond his reach; but it does not seem worth while to assume that those who are to use this method are such poor mathematicians that the work should be modified in this way for their benefit. The author has done well in this new work in making a straightforward, logical development of the method and its applications. In a cursory examination of the work, it does not appear that the author has, in general, enlarged the book by materially adding to the theoretical part, which was already sufficient for the purposes in view. The additions are found in the practical portion of the work, and are of a nature to considerably enhance its value to the civil engineer, for whom the book is primarily intended.

It has seemed to the writer that the introductory chapter, which treats of the general principles of probability, might have been enlarged to advantage, or at least that the reader should have been referred to some good source of information, such as the excellent little book of Whitworth on choice and chance; as this is a subject respecting which he probably has little or no previous knowledge. Taken as a whole,

this is a very useful and much-needed textbook, and will exert a strong influence to extend the knowledge of the correct method of the comparison and combination of observations, which is so essential, not only to the progress of astronomy and geodesy, but to physics and chemistry as well, and to every branch of science which deals with refined measurements of quantity of any kind by the help of instruments of precision.

THE SOCIETY FOR PSYCHICAL RESEARCH.

Proceedings of the Society for psychical research. Vol. i. (containing parts i.–iv.). London, *Trübner & Co.*, 1883. 337 p. 8°.

THE four reports of the Society for psychical research which have been issued at intervals during 1882 and 1883 have now appeared in the form of a handsome volume, and it cannot be denied that they constitute a formidable body of evidence in favor of certain beliefs which have hitherto been looked upon with peculiar suspicion and distrust. A brief *résumé* of the testimony does not do it justice, for it derives its weight from the cumulative effect of its large amount. No one who is interested in bringing fresh regions of ignorance under the domain of scientific investigation should fail to read the proceedings for himself.

The society was organized on Feb. 20, 1882; but several of its members had been engaged in private research in the same direction for some years before. Its object was stated to be the investigation of an important body of remarkable phenomena, resting upon the testimony of many competent witnesses, including observations recently made by scientific men of eminence in various countries, and *primâ facie* inexplicable on any generally recognized hypothesis. The distinction of its founders is such as to completely dissociate it from the race of the long-haired, and to insure at once respectful consideration for whatever facts it vouches for. They include such names as Balfour Stewart, Arthur Balfour, Professor Barrett, Edmund Gurney, F. W. H. Myers, Archbishop French, and Professor Henry Sidgwick (the president). The members are not committed to any theory, and are not advocates of any cause. It is their intention to remove, if possible, what they justly say is a great scandal, — the existing state of absolute doubt as to whether phenomena testified to by a large number of generally credible witnesses, and of great scientific importance if true, can be properly authenticated or not. Their experiments are conducted with the most rigid precautions against deception and mistake, and, what is equally important, recorded with scientific precision. Six committees were formed for the consideration respectively of thought-reading, mesmerism, Reichenbach's experiments in regard to a peculiar sensitiveness to electric currents, apparitions and haunted houses, physical phenomena, and the collection and collation of existing materials bearing on the history of these subjects. Of their several reports, those of the committee on thought-reading, or thought-transferrence, as they call it later, are the most striking. The signification of the term 'thought-transferrence' is limited to the communication of a vivid impression or a distinct idea from one mind to another, without the intervening help of the recognized organs of sensation. No account is taken, very naturally, of experiments in which there is physical contact between the persons concerned, or in which there is the slightest possibility of conveying information by sight or hearing. The extreme perfection to which a code of signals may be brought leads the committee to distrust all observations where two particular persons are necessary for the results obtained. Their most remarkable subjects for thought-transferrence have been found in a family in Derbyshire, that of Mr. Creery, a clergyman of high character, whose integrity has, as it happens, been exceptionally tested. He has five daughters, of ages between eleven and eighteen, all thoroughly healthy, and as free as possible from morbid or hysterical symptoms. All of these children except the youngest are able to designate correctly, without contact or sign, an object fixed on in the child's absence, — not, indeed, every time, but far more frequently than probability would allow as the result of chance. The child, on returning to the room, stands close to the door, amid absolute silence, with her eyes on the ground: often she does not return, but guesses from the adjoining room, with the door closed. The children have been experimented upon at their home by the committee, by Professor Barrett, by Mr. and Mrs. Sidgwick, and by Professor Balfour Stewart, as well as at the houses of different members of the committee at Cambridge and at Dublin. The objects guessed have been chiefly cards from a full pack, and numbers between ten and one hundred; but remarkable success has been obtained, also, in guessing names chosen at random, as in the following list: —

William Stubbs.	'William Stubbs.'
Sophia Shaw.	'Sophia Shaw.'
Timothy Taylor.	'Tom Taylor — Timothy Taylor.'
Isaac Harding.	'Isaac Harding.'
Albert Snelgrove.	'Albert Singrore — Albert Grover.'
Tom Thumb.	'Tom Thumb.'
Cinderella.	'Cinderella.'
Chester.	'Manchester — Chester.'
Pipe.	'Plate — paper — pipe.'
Fork.	'Fork.'
Corkscrew.	'Corkscrew.'
Tongs.	'Fire-irons — poker.'

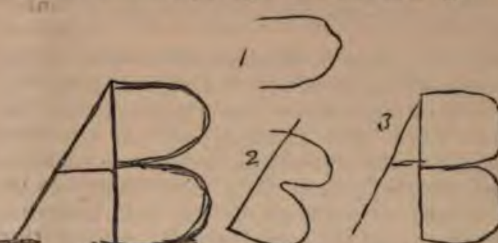
From the summary of results, it appears, that, out of every 610 trials with playing-cards, there were 118 correct guesses on the first trial, and 76 on the second; or that, counting the first trial only, there was 1 correct guess out of every 5.17, instead of 1 out of every 52, as would be given by chance alone. Of 260 numbers, 68 were guessed correctly the first time, and 35 the second time, or, on the first trial, 1 out of every 3.82; whereas from chance would have given only 1 out of every 90. Where the trial is counted as a failure, it frequently happened that the suit, or the number of pips of the card, or one figure of the number, was guessed correctly. The partial successes, as in the guesses for 'pipe' and 'tongs,' given above, strike us as even more remarkable, and more likely to throw light upon the subject, than the complete ones. The children, when questioned, agree in saying that two or three ideas of similar objects come before their minds, and that, after a moment's reflection, they select that which stands out with the greatest vividness. Their power, instead of improving with use, has been gradually diminishing. At first, especially when they were in good humor, and excited by the wonderful nature of their guessing, they seldom made a mistake. They have been known to name seventeen cards right in succession.[1] Their gradual decline of power somewhat suggests the disappearance of a transitory pathological condition. On the other hand, a larger number of good subjects has been found than there was reason at first to look for.

Much more remarkable than experiments with cards or numbers, where there is at least an appreciable chance of getting right by accident, are those in which an impression of a drawing is conveyed from one mind to another, without contact, or any conceivable use of the ordinary means of communication. In these

ORIGINAL. REPRODUCTION.

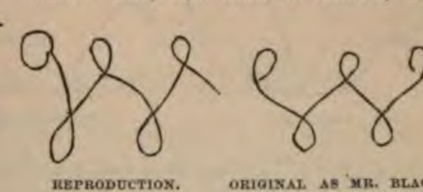
Inner circle begun at point marked +, and then carried round in one continuous line from left to right.

experiments, Mr. Blackburn, an associate of the society, who is described as a very painstaking and accurate observer, is the operator; and Mr. Smith, a young mesmerist of Brighton,



ORIGINAL. REPRODUCTION (THREE ATTEMPTS).

is the subject. Mr. Smith is seated, blindfolded, at a table in one of the rooms of the society; paper and pencil are within his reach, and a member of the committee is seated by his side. Another member of the committee leaves the room, and outside the closed door draws some figure at random. Mr. Blackburn is now called out, the door is closed, and

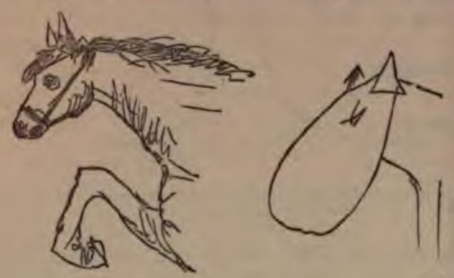



ORIGINAL. REPRODUCTION. ORIGINAL AS MR. BLACKBURN REMEMBERED IT.

the drawing is held before his eyes for a few seconds. Closing his eyes, Mr. Blackburn is led back into the room, and placed, standing or sitting, behind Mr. Smith, at a distance of some two feet from him. After a brief period of intense mental concentration on Mr. Black-

[1] The chance of doing which, by accident, is as 1 to 52^{17}.

burn's part, Mr. Smith takes up the pencil, and, amidst the absolute silence of all present, reproduces as nearly as he can the impression he has received. Mr. Blackburn keeps his eyes closed (sometimes they are bandaged as an aid to concentration); and he has not touched Mr. Smith, and has not gone in front of him, or in any way within his possible range

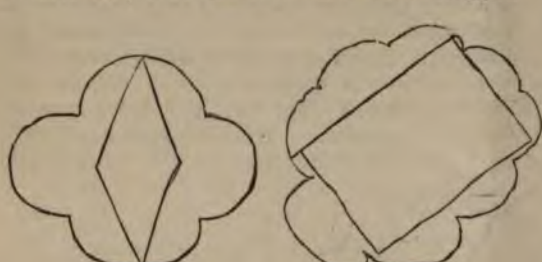


a b

ORIGINAL. REPRODUCTION.

Mr. Smith had no idea that the original was not a geometrical diagram. He added line *b* some time after he had drawn line *a*, 'seeing a line parallel to another somewhere.'

of vision, since he re-entered the room. Sixty pages of the drawings and reproductions are given, — facsimiles of the originals from which they have been photographed on the wood blocks. The reproductions are rude copies of the drawings, such as a child might make, blindfold, of a picture he had just seen; but in every case the resemblance is recognizable, and sometimes it is very exact. A particularly good one was made, when, with a view of removing all doubt as to possible auditory communication, Mr. Smith's ears were stopped



ORIGINAL. REPRODUCTION.

with putty, a bandage was tied round his eyes and ears, a bolster-case was fastened over his head, and over all was thrown a blanket which enveloped his entire head and trunk; and Mr. Blackburn sat behind him as still as it is possible for a human being to sit who is not concentrating his attention on keeping motionless to the exclusion of every thing else. To profit by a code of signals in this case, Mr. Smith would have had to extract the putty from his ears, and, still smothered in bolster-case and blanket, to detect periodic variations in Mr. Blackburn's breathing imperceptible to the committee, and to interpret them into a description of a very irregular figure. This hypothesis seems to the committee an extreme one, but they intend to meet it by still further varying the conditions of future experiments.

The record is given of another set of experiments made upon two young ladies at Liverpool, under the strictest conditions, by Mr. Guthrie and Mr. Birchall. The following were among the guesses: —

A gold cross.	'It is yellow — it is a cross.'
An egg.	'Looks remarkably like an egg.'
A penholder, with thimble inverted on the end.	'A column, with something bell-shaped turned down on it.'
Letter Q.	'Q.'
A dark-crimson apple.	'Is it round — a dark-red shade — like a knob of a door? — It is an apple.'
A key.	'A little tiny thing, with a ring at one end, and a little flag at the other, like a toy-flag.' Urged to name it, replied, 'It is very like a key.'
A pair of scissors standing open and upright.	'Is it silver? — No: it is steel — it is a pair of scissors standing upright.'

The usual phenomena were obtained by the committee on mesmerism, but with the utmost precaution against collusion and fraud. The cases which do most to stagger a cultivated scepticism are those in which the subject remains in a perfectly normal condition, with the exception of *local* effects produced on him without contact, and without any possibility of expectation on his part. The following experiment was repeated thirty or forty times without a single failure. The subject was blindfolded and seated at a table, on which his ten fingers were spread out before him. A screen formed of thick brown paper quadruply folded was placed in front of him, extending far beyond him in all directions. Two of his fingers were then selected by one of the committee, and silently pointed out to the mesmerizer, who proceeded to make very gentle passes over them; and to prevent the communication to the subject of a sensation of change of temperature, or a current of air, a member of the committee made, as nearly as possible, similar passes over two others of his fingers. After a min-

ute or less, the two fingers mesmerized proved to be perfectly stiff and insensible: the points of sharp instruments might be plunged deep into them, or a lighted match might be applied to the sensitive region around the nail, without producing a sign or a murmur. It is difficult to suppose that an ordinary youth, sitting with relaxed limbs in quiet unconcern, would be able to control, by the exercise of his will, every sort of reflex start or twitch when a naked flame is applied to one of the most sensitive parts of his person. To meet such an objection, however, the experiments were repeated with other subjects with equal success, — one of them a delicate woman, whose shrinking from pain was such that the prick of a fork on one of her unmesmerized fingers would cause a half-hysterical cry. The hands of the subject may even be mesmerized when he is in the mesmeric sleep; and then the usual clap and call restore him to consciousness, but do not permit him to remove his hands from the sofa, to which they seem to be glued, until after they have been separately released.

We pass over the report of the Reichenbach committee, of the literary committee, and of the committee on haunted houses, but not because they do not contain a great deal of very interesting and striking matter. The addresses of the president, too, are models of clear, careful, and forcible writing; and the proceedings as a whole cannot fail to produce a strong effect upon a reasonably unprejudiced reader, especially when it is considered that all this is in addition to the varying amount of testimony and experience that has been for years in the possession of nearly all of us. In no other subject has there been such a long dispute over the reality of the phenomena: even the witnesses to globular lightning have gained credence for themselves at last. No other subject, as is perfectly natural, has been so inextricably mixed up with fraud and chicane, and has fallen, in consequence, under such a weight of obloquy. There has usually been, besides, a peculiarly 'unwashed' flavor about the possessors of these mysterious powers which are denied to people in general. The travelling mesmerizer has not been an attractive specimen of humanity, and to that fact has been allowed more than its due effect. In other undecided scientific questions, weight of authority has counted for something, but not the weight of a man's family connections. Even when it was said that such unexceptionable witnesses as De Morgan and Wallace and Crookes had become convinced that certain facts not generally admitted were really facts, one could not help believing that they differed in some way from the ordinary sane scientific man, and that some peculiar crookedness of mental vision was the source of their strange belief. Another refuge of incredulity has been national and sectional distrust: it was chiefly outside of the centres of learning that such things went on. Mr. Sidgwick was once told by a German, that they happened only in England or America, or France or Italy, or Russia, or some half-educated country, but not in the land of *geist*. If this society does not at once convince all the world of the truth of its phenomena, it has at least accomplished the feat of suddenly elevating them into the region of respectability; and hereafter any one can admit his belief in them without shamefacedness. Now that mesmerism and mind-reading have ceased to be exclusively the property of travelling-shows and after-dinner entertainments, and have become a subject of experiment in laboratories, it is to be hoped that their extent and limitations will be speedily defined, and that the vagueness and haze in which they have hitherto been enveloped will soon be replaced by definite knowledge.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Study of metamorphic rocks. — Prof. R. D. Irving, after consultation with the other lithologists of the survey, and with Dr. Williams of Baltimore, is confirmed in his view of the occurrence of a secondary brown hornblende (as announced by him in 1880 and in 1883) produced by the alteration of augitic minerals. This occurrence is one hitherto denied by the best German authorities; and the cases described by Mr. Irving have been supposed to be probably cases of envelopment such as are well known to occur. This, of course, has no reference to the occurrence of a green hornblende as an alteration product of augite. Most of the sections made by Mr. Irving and his assistants, showing secondary hornblende, show this variety, only a few localities yielding rocks in sections of which the brown variety occurs as a secondary product.

Mr. Merriam, of Professor Irving's division, has been experimenting on the photographing of thin

rock-sections directly with the microscope, with very satisfactory results. It is hoped to use this method of preparing plates for publication, to be reproduced by some heliotype or autotype method. Mr. Merriam took the field the latter part of May in south-eastern Dakota, where he proposes to study the quartzites exposed at a number of places between the James River and the Minnesota state line.

Mr. Vanhise, during May, continued his microscopic work, having prepared some forty new written descriptions of greenstones, chiefly from the original Huronian of the north shore of Lake Huron. The microscopic as well as field study of this formation has been found necessary, as it forms the type with which the rocks of all the other so-called Huronian areas must be compared.

Mr. Vanhise has also prepared a number of new sections, including some additional ones of the sandstones which he has described in his paper on secondary enlargements of felspar fragments published in the *American journal of science* for May. The new sections show the enlargements even more distinctly than the ones previously described by him, and leave no room for doubt as to the correctness of this very important observation. Mr. Vanhise will probably take the field in north-western Michigan in the agogebic belt of Huronian schists.

Unalashka sands. — Mr. J. S. Diller's report on the Unalashka sands will be published by the U. S. signal-office, and the geological survey has promised to examine and report upon any other volcanic sands or atmospheric dusts that may be collected by that bureau. Their observers, especially on Mount Washington and Pike's Peak and in Alaska, have been instructed to collect and preserve any sands or dusts that may fall, or be brought down from the air by rainfall.

Artesian wells. — Prof. T. C. Chamberlin has prepared a paper on artesian wells for the fifth annual report of the survey.

Dr. Peale has reports from Montana that work has been resumed on the artesian wells at Helena and at Billings, and that the second boring at Miles City, on the Yellowstone, reached flowing water at a depth of four hundred and fifty feet, which is a hundred feet deeper than in the first well.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Cincinnati society of natural history.

July 1. — Dr. Walter A. Dun read a paper on the recent floods in the Ohio valley. He tabulated the measurements of all the floods since 1832 of which we have trustworthy records. The river has reached the height of fifty feet and over, fourteen times since 1832. All of these floods except one (that of August, 1875), have occurred in the winter months, and seven in the month of February. The extremely high water is the result of a long-continued and widely extended rainfall upon an accumulation of ice and snow, or upon the frozen ground. These conditions are sufficient to account for floods, not considering the question of the reduction of timber areas. —— Mr. Charles Dury, in a brief paper, described the finding, for the first time in our locality, of Adranes LeContei, a beetle inhabiting ants' nests. This beetle is kept by the ants for the honey-like secretion which it exudes. —— Mr. Joseph F. James stated that a recent discovery in the lower Silurian rocks of Clark county, O., makes it clear that some of the so-called 'fucoids' are undoubtedly caused by the oscillation of crinoid stems over the soft mud.

Brooklyn entomological society.

June 29. — Mr. J. B. Smith read a paper on some structural modifications of the Noctuidae with reference to their geographical distribution. Three typical faunae inhabit America north of Mexico; the northern of which, the Labrador fauna, is typical; the eastern agreeing in all essential characteristics with that of central Europe; and the western, peculiar to this country, reaching to the Pacific, thrusting long extensions into the southern states, and small spurs into the middle states. The northern fauna is typically represented by Anarta and the Pachnobia group of Agrotis, and is characterized by small head, smooth clypeus, often narrow ovate eyes, plump figure, and long, hairy vestiture. The northern species of Plusia, of which P. Hochenwarthi may be considered typical, share this tendency to ovate eyes, and, having also the tibiae spinose, must receive separate generic designation. Caloplusia is proposed to designate these forms, which usually also have the secondaries yellow. This northern fauna is indicated again in the high northwest, and is traceable in the mountainous regions of northern New York and the New-England states. The eastern fauna is characterized by more proportionate head, the front usually smooth, the body vestiture scaly, usually overlaid or intermixed with hair. The tibiae, when armed, are usually all of normal length; and the armature consists of spines. The maculation is normally noctuidous, and the wings are ample. The western fauna is most peculiar. The front is strongly modified, tuberculate, rugose, or excavate: the tibiae are heavily spinose, the anterior pair often shortened, and the armature consisting of long, corneous, claw-like processes. The ♀ oviduct is also more or less prominently extruded. As a whole, the heliothid type prevails; and even Agrotis takes a distinct heliothid tendency in the tuberculate front and heavily armed fore-tibia of the western species. Belonging to no special locality, but perhaps more distinctly south-western, is that group of which Phurys and Syneda are typical, and which agrees in distribution with the Tenebrionidae among the Coleoptera. The speaker asked, What is the peculiar circumstance

that demands of our western fauna this abnormal frontal development, the heavy tibial armature, and the corneous, lengthily extruded ♀ ovipositor?

Torrey botanical club.

June 10. — Mr. P. H. Dudley exhibited specimens and gave a brief account of his recent studies of wood sections. A large number of micro-photographs of transverse, radial, and tangential sections of our timber-trees were shown. Among the specimens were Sequoia sempervirens, in which attention was called to the very large cells (none less than a tenth of an inch in length), and to the fact, that, in this and other conifers examined, the pits in the cell-walls are only seen in abundance in the radial sections; Catalpa speciosa, which has lately been extensively employed for railroad-ties in the west; Ailanthus glandulosus, which the speaker stated he had found to contain the greatest number and largest ducts of any wood yet examined; Liriodendron tulipiferum, in which the ducts are very numerous but small; Maclura aurantiaca, in which the parenchymatous tissue within the ducts was plainly noticeable. In the white oak, chestnut, and black walnut, it had been observed that these parenchyma cells shrink away, in drying, from the inside surfaces of the ducts and from each other, then appearing as separate vesicles.

NOTES AND NEWS.

A LIST of the published writings of Spencer Fullerton Baird from 1843 to 1882, with indexes, compiled by George Brown Goode, the first of a proposed series of bibliographies of American naturalists, forms Bulletin No. 20 of the U. S. national museum. In a prefatory note, Mr. Goode explains that since 1874 he has been collecting materials for 'An index-bibliography of American ichthyology,' which will embrace "not only anatomical and descriptive ichthyology, but the literature of the fisheries, angling, fishery legislation and diplomacy, fishery statistics, and the commerce of the fisheries." Besides the titles and references, notes upon what each paper contains, and, in case of important papers, synopses of their contents, will be given: these notes will include references to every published engraving. It is hoped to finish this work in 1884, including in it material published before July of that year. The bibliography of Professor Baird's writings is apparently in part material collected for the above-mentioned work, although notes are wanting to many titles. Other special bibliographies of prominent naturalists are in preparation, among which one of Charles Girard and of Theodore Gill, by Mr. Goode, and one of Isaac Lea by Mr. Newton P. Scudder, are announced.

The articles recorded for Professor Baird number 1,063 titles; the numerous notices, abstracts, and reviews which appeared in *Harper's magazine* and in *Harper's weekly* being cited only in their reprinted form in the *Annual record of science and industry*. The general plan of this special bibliography is commendable. An excellent biographical sketch of Professor Baird follows the prefatory note, and is supplemented by a portrait, which Professor Baird refused to allow to be inserted in the work, but which Mr. Goode has kindly sent to as many as possible of the recipients of the bibliography. It is the same which appeared in *Science*, No. 5. The list of genera (1) and species (32) named in honor of Professor Baird is pardonable material, perhaps, with which to fill three pages of a government publication. This form of honoring the names of naturalists means little, and has just reached the maximum of its absurd development in England, where an entomologist has calmly named a butterfly after himself. The real honor due Professor Baird as organizer and scientific worker is not enhanced by this valueless list. The chronological catalogue of papers occupies 246 pages of the work. In some cases the notes are long, and embrace lists of the genera and species, and even of the varieties, treated of in some of Professor Baird's more extensive works. This may be a practicable or even a desirable method in bibliographies of workers in vertebrates, but would become unwieldy were it carried out for those whose work lay in some other portions of the animal kingdom. Following the chronological catalogue are a systematic catalogue and a list of species discussed and illustrated, both referring, by number and by condensed title, to the list of titles. An alphabetic index of subjects — not scientific names — closes the bibliography.

A commendable feature of this bibliography is the complete independence of each entry, allowing the catalogue to be cut and pasted on cards without additional writing. There are points in which the mode of recording might be bettered. Initial capital letters are very properly discarded, although with some inconsistency of usage, from numerous words in titles of papers, following the practice of many modern bibliographers; but why should the compiler retain initial capitals in such unimportant parts of the titlepage as 'With Eighty-seven Plates of Original figures,' on p. 83? Considerable condensation might be made by using only arabic numerals, and by considering p., pl., fig., and like abbreviations, plural as well as singular. Thus 'pp. i.-xvii., 1-496, pll. i.-xxxii.,' would be more tasty, and more easily read, if printed, 'p. 1-17 + 1-496; pl. 1-32.' The space occupied by | . . . |, in recording titlepages, might be given to more practical purpose, for indicating the actual size of volumes in centimetres (or even in inches), instead of using, as was done, the indefinite indications 8vo and 4to.

— *Nature*, June 19, states that letters addressed to the secretary of the committee of the British association for the exploration of Kilimanjaro have just been received from Mr. H. H. Johnston, dated from the British residency, Zanzibar, May 13. After consultation with Sir John Kirk, Mr. Johnston had selected the Mombasa route for Kilimanjaro, and was expecting to depart for that port in about a fortnight's time. The country between Mombasa and Chaga was said to be quiet, and to present no serious difficulties in the way. Mr. Johnston had succeeded in obtaining the services of three of the same bird-

skinners that had been employed by Dr. Fischer, and of a botanical collector trained under Sir John Kirk, of whose kindness and assistance he speaks in the highest terms. Mr. Johnston, in spite of the trying climate of Zanzibar, was in excellent health, and had strong hopes of the success of the expedition.

We are pleased to learn that Mr. Joseph Thomson has arrived safely at Zanzibar from the expedition he undertook to the Masai region. It will be remembered that Mr. Thomson left England in the end of the year 1882; his object being to proceed by Mount Kilimanjaro to the almost unknown country of the Masai, and to settle the question of the existence of a Lake Baringo to the east of Victoria Nyanza. Mr. Thomson left Zanzibar in the spring of last year, but, after proceeding some distance, found the country so disturbed owing to the recent passage of a German explorer, Dr. Fischer, that he was compelled to return precipitately to Mombasa. In July last, however, he started again, and has evidently accomplished his work in a way quite worthy of his previous record. Passing round the north-eastern side of Mount Kilimanjaro, Thomson proceeded north to Lake Naivasha, halfway between Kilimanjaro and Mount Kenia; then on to the latter mountain, and, by way of Lake Baringo, to the shores of Victoria Nyanza. This latter lake he skirted as far as the outlet of the Nile, returning by a more northerly route, striking the west coast of Lake Baringo, and proceeding south and south-east by Ukambani to Mombasa. It is satisfactory to record that no lives have been lost except by illness. The telegram which the Geographical society has received from Sir John Kirk does not, of course, enter into minute details; but, from its general tone, it is evident that Mr. Thomson will have an interesting and instructive story to tell when he returns. The telegram does not state positively that Mr. Thomson found a lake where Baringo is placed on our maps; but, as Baringo is mentioned as having been touched at, it seems most probable that the information obtained from natives by the sagacious Wakefield is correct. All the country traversed by Mr. Thomson's expedition to the north of Lake Naivasha is new ground, hitherto untraversed by any explorer. Dr. Fischer, in his recent expedition, reached only as far as the lake just mentioned.

— In the anthropological section of the British association meeting at Montreal, the following specially American topics, as to several of which Canada affords important evidence, are suggested for papers to be read: The native races of America, their physical characters and origin; Civilization of America before the time of Columbus, with particular reference to earlier intercourse with the old world; Archeology of North America, — ancient mounds and earthworks, cliff-dwellings and village-houses, stone architecture of Mexico and Central America, etc.; Native languages of America; European colonization, and its effects on the native tribes of America. The papers on each subject will, as far as possible, be grouped for reading on the same day, so as to insure a general discussion.

— The *Daily Iowa capital* of June 24 contains an account, by Prof. H. W. Parker of Grinnell, of a large mammoth recently found in that city in digging a cellar. One of the remains is a molar tooth fifteen inches long, and which might have been sixteen or more inches before the end of the crown was broken off and lost. It weighed fifteen pounds when first unearthed. The other principal relic is a tusk, which must have been at least eleven or twelve feet long: it now measures, along the centre, seven and a half feet, and, where broken off at the end, the diameter is four inches; the largest diameter is eight inches. Two years ago a small tooth, and fragments of bone, including part of pelvis, were found in digging a cellar adjoining. Other fragments were exhumed last year from a cellar about three rods north of the site of the tusk. The tusk occurred five feet below the surface, the tooth and other fragments about eight, in yellow clayey loam. The Davenport elephant-bones, from a railroad cut in the bluff, were found in yellow clayey loess, twenty-one feet below the surface, and separated by three feet of bluish clay from an old peat-bed and ancient soil, probably similar to that which is said to exist everywhere under our prairies, at an average of twenty-five or thirty feet below the surface. At Davenport the bowlder clay of the glacial period underlies the ancient soil.

— One of the results of the deep-sea dredgings of the Albatross was the discovery, at a depth of nineteen hundred and seventeen fathoms off the Atlantic coast, of probably the largest known amphipod crustacean, Eurythenes gryllus Bock. The few previously known specimens came from Cape Horn, Greenland, and Finmark, and have apparently all been taken from the stomachs of fishes. This species, and its occurrence in the extreme arctic and antarctic seas, have been much discussed, and are the subject of a long memoir by Lilljeborg; but the apparently anomalous distribution is explained by its discovery in deep water, off our middle Atlantic coast.

— Dr. C. V. Riley, U. S. entomologist, has gone to Europe, partly for rest, partly on special work of the U. S. agricultural department.

RESERVOIR BUTTE, SHOWING TERRACES OF THE BONNEVILLE SHORE-LINES.

SCIENCE.

FRIDAY, JULY 18, 1884.

COMMENT AND CRITICISM.

In a previous number of *Science* we have alluded to several items of scientific interest in the sundry civil bill. All these items, except that relating to the naval observatory, have passed in a satisfactory form. The electrical commission, which is to prosecute its labors during the Franklin institute exhibition next autumn, is to be appointed by the president. No special number of commissioners is prescribed, so that the composition of the commission is entirely in the hands of the authorities. The most difficult question connected with the make-up of the commission will be that of admitting into its ranks those who are interested in the various electric-light companies, or who are employees of such companies. There is no doubt whatever, that, if any such interested parties are appointed on the commission, care should be taken that the leading companies be equally and fairly represented. That this could be done in a satisfactory manner does not seem at all likely; and we must therefore look forward to a disinterested commission, before which all parties interested shall have a fair hearing. The amount appropriated for expenses is seventy-five hundred dollars.

An appropriation of five thousand dollars has been made for the expenses of the meridian conference called by our government. Provision has been made for two additional conferees on the part of our government, thus conforming to the views expressed in a recent number of *Science*. That course seems to have been suggested independently by the government, and was, no doubt, prompted by the evident desirability of having astronomical science well represented in our discussion of the question.

The question of the organization of the signal-service, coast and geodetic survey, geological survey, and hydrographic office, is to be considered by a congressional commission of three senators and three representatives. The senators are Messrs. Allison, Hale, and Pendleton; the representatives, Messrs. Lowry of Indiana, Herbert of Alabama, and Lyman of Massachusetts. The selection of Mr. Lyman is understood to be due to his membership of the National academy, which designed the organization of the geological survey five years ago.

The proposition authorizing the appointment of a scientific commission to inquire into the organization of the naval observatory, under direction of the secretary of the navy, was rejected by the senate after passing the house. The significance of the rejection hardly needs to be commented upon, further than to remark, that it is well understood to be due to naval influence, and may be taken as an index of the willingness of naval officers to have their management inquired into.

Two academic honors have recently been conferred in this country upon scientific men, which are worthy of note because more rare and costly than such distinctions usually are. At New Haven, on the day before commencement, a bronze statue of Professor Silliman, for more than fifty years a teacher of chemistry, mineralogy, and geology in Yale college, and the founder of the *American journal of science and arts*, was placed on its pedestal near the new chapel. The artist is Prof. John F. Weir of the Yale art school. He had not the advantage of knowing Professor Silliman, but from numerous existing portraits, and from a study of the personality of his subject, he has succeeded in reproducing and perpetuating, in a very satisfactory manner, the aspect, the bearing, and the character of one of the pioneers in American scientific education. The figure is standing, is larger than life, and is in the costume of the day.

skilfully draped with a cloak. In the right hand a crystal is held, the only symbolism which the artist has employed. The inscription is restricted to the name, the title, and the dates; and it might well be supplemented, on the other side of the pedestal, with some descriptive phrase or with an appropriate motto. Without such accessories, the monument barely suggests the affectionate regard in which Professor Silliman was held by those who graduated at Yale during the first half of this century. The regret has also been expressed, that the statue was not placed in or near the Peabody museum of mineralogy and geology, where everybody would be reminded, that, when Silliman began his work, the collections of Yale college (now so magnificent) were packed in a candle-box, and carried to Philadelphia for identification. The man and his influence would thus be inevitably associated. If these two changes could be made in the inscription and the position, this well-deserved and well-executed memorial would be still more satisfactory than it is to those who honor the teacher whom it represents.

The other honor to which we refer is that of a medal struck at the U.S. mint in Philadelphia, at the request of the colleagues and friends of Professor Sylvester, to commemorate his residence in Baltimore during a period of seven years, marked, among other things, by the establishment of the *American journal of mathematics*. The medal, in size and general aspect, is not unlike that which was struck in commemoration of the life of Agassiz. On one side is an accurate and spirited portrait of the mathematician, with the name Sylvester: on the reverse a Latin inscription commemorates the fact that he was for seven years professor of mathematics in the Johns Hopkins university, — from 1876 to 1883. The original medal in gold was sent to Professor Sylvester, in his new home in the University of Oxford; a duplicate in silver was retained in Baltimore; and a few impressions in bronze have been distributed among his scientific friends and correspondents.

Attention is called elsewhere in our columns to the laborious researches and brilliant discoveries by Koch before he was sent by the German government to Egypt and India to study cholera. Work of value upon the subject of micro-organisms is not done in this country, nor will it be until some such encouragement is offered to investigators, as is the case in France and Germany. This kind of research requires the rare combination of many forms of training, added to a critical, analytical, and judicial mind. These we can have; but until the facilities for the work are offered, until the necessity for personal sacrifice and self-denial is done away with, we can hope for no better work in the future than has been done in the past: in other words, what is first needed in order to place our own investigations upon an equality with those of the two countries mentioned above, is a thoroughly equipped, fully endowed laboratory, with a strong corps of well-trained and salaried officials.

The congressional bill, offering a reward of one hundred thousand dollars to the discoverer of the cause of yellow-fever, will meet with no claimants worthy of the name from workers in this country. It may, and probably will, attract a crowd of mycologists; but the hope that any thing of permanent value will come from it is an exceedingly faint one. The investigation can only be made through the outlay of private capital, which will be slow to seek any such channel for investment. The first expense would be great, and the total disbursements necessary for any complete experimental evidence upon the subject would be beyond the calculations of any but those familiar with such work. The true way to encourage such an inquiry lies in the establishment of a commission composed of men thoroughly trained and qualified for the work, and then to treat it as the German government has treated its cholera commission; that is, to give it full powers and funds to allow the prosecution of its labors to the end.

So far as Koch's work upon tuberculosis is

...monument of ...ered nothing ... The strength ...n in the least ...his experiments ...justness of his ...ontrovertible. As ...e bound to consider ...ulosis is found, and ... contained in, the ba... ...m all honor is due for ...teness of his investiga... ...rtant subject.

...of the last annual meeting ...ademy of sciences, reference ... gift of eight thousand dollars ... of the late Dr. J. Lawrence ...uber of the academy. The deed ... recently been executed, and ...at the interest of the fund shall be ...riking a gold medal of the value of ...ndred dollars, to be called the 'Law... ...mith medal,' and to be awarded by the ...ety, not oftener than once in two years, ... any person in the United States of ...erica, or elsewhere, who shall make an ...ginal investigation of meteoric bodies, the ...sults of which shall be made known to the ...ublic; such result being, in the opinion of the National academy of sciences, of sufficient importance and benefit to science to merit such recognition." The investigation for which the award is made, or its completed publication, must "have been made since the time of the last preceding award." Preference is given to a citizen of the United States, when the choice may lie between such a one and a foreigner. Any sums which may accumulate from the interest of the fund, above what is required for the purposes specified, is to be used "in aid of investigation of meteoric bodies, to be made and carried on by a citizen or citizens of the United States of America."

We recall but three other important honorary awards at the disposal of learned societies in this country, — the Magellanic, the Rumford, and the Walker, to mention them in the order of their foundation. The Magellanic, founded by John Hyacinth de Magellan, is an "oval plate of solid gold, of the value of ten guineas," which may be annually bestowed by the American philosophical society "to the author of the best discovery or most useful invention relating to navigation, astronomy, or natural philosophy (mere natural history only excepted);" but the discovery must be unpublished, and never before publicly rewarded. We are not aware that it has ever been bestowed. The Rumford, founded by Count Rumford, is a gold and silver medal, bestowed biennially by the American academy of arts and sciences for notable researches by an American in light or heat. The Walker, founded by the late Dr. William J. Walker of Boston, is a money-prize of from five hundred to a thousand dollars, given once in five years by the Boston society of natural history to an American for specially valuable investigations in some department of natural history. The addition to this meagre list is therefore most welcome. Through the excellent provision granting the power of using any surplus in the direction of research, the necessity of awarding the prize to claimants of insufficient merit is avoided, and the branch of investigation to which it applies is thereby doubly fostered: but we wish the requirement that the investigation which is crowned must have been made since the previous award, could be modified to a definite term of years; since, if two important investigations claimed the award, one would now be forever debarred.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The use and spelling of terms, and some facts in embryology.

In *Science*, No. 73, a critic notices my recently published 'Contribution to the embryography of osseous fishes.' I reply as follows: Fault is found with my terms 'embryography,' 'yelk,' etc. I chose the word 'embryography,' not from a mere pedantic or eccentric whim, but because it was an expressive term, and covered what I meant in the general discussion, or *description*, of the development of a considerable

number of species. The word 'yelk' is spelled according to the most approved usage throughout my memoir, both Webster and Worcester agreeing in this; and I would commend to my critic's attention the remarks relating to this word to be found in the work of the latter authority, where both Johnson and Walker are also cited in favor of the same spelling.

The expression of opinion by my critic as to the relative value of previous literature is unfortunate. Hoffmann's paper on the teleostean egg was cited for the very good reason that it was undoubtedly the most thorough and consecutive upon its special subject, which had appeared up to that time, or even to the present. No American work can yet claim such a distinction.

The charge that I have 'padded' my paper with unnecessary quoted matter is unfair; for, out of one hundred and eighteen pages of text, nine are taken up with citations,—a proportion greatly exceeded in the papers of many competent authorities. And I ask my critic, in all fairness to me, if, by throwing out any one of the quoted passages, the paper as a whole would not lose in thoroughness and clearness of statement; for the object of my paper was to give a general statement of the facts relating to the development of fishes, so that it might be safely referred to, especially as to the early stages.

Whether my critic sees fit to accept my views upon the layer which I have termed the 'yelk-hypoblast,' is a matter of indifference to me. For his benefit, I may cite the names of the following masters in embryology, who agree with me more or less closely: Vogt, Kupffer, Hoffmann, Rauber, Gensch, Ziegler, and even, in one sense, His and Kölliker.

JOHN A. RYDER.

Smithsonian institution, Washington, D.C., June 30.

[Mr. Ryder will not find 'yelk' used by the leading embryologists, either in England or America; 'yolk' being the form used by Huxley, Balfour, Allen Thompson, Agassiz, etc. 'Embryology' is also similarly employed, instead of 'embryography.' In our notice, it was not said that either word was incorrect; but we meant exactly what was printed, that they are a 'little eccentric.' In regard to Hoffmann's paper, it is by no means 'the most thorough,' but contains important errors. We fail to see how the value of Hoffmann's paper is affected by American work being considered less good. We regard Mr. Ryder's own essay as much more valuable than Hoffmann's. As to the padding, we think the charge fair that the essay contains 'an unnecessary number of lengthy extracts *and abstracts*:' the latter Mr. Ryder ignores. It is generally understood that very little editorial supervision is exercised over most of our government publications: hence they are often diffusely written, and charged with much which might better be omitted. We do not think that Mr. Ryder intentionally put in matter to fill out; but we do think he failed to leave out much that he would have omitted if his article had been for a carefully edited scientific journal. As to the 'yelk-hypoblast,' the future will decide between our opinions.

Mr. Ryder is under a misapprehension, if he thinks our notice was intended to be unfavorable; for although we pointed out some blemishes, as we held them to be, we intended to convey the impression that the substance of the work appeared to us very meritorious: therefore we said that 'the work had been done with evident care and patience,' and mentioned a long series of observations which might be 'signalized as being of especial interest and importance.' — ED.]

A remarkable new type of mollusks.

A very remarkable new form of Mollusca has recently been submitted to me for examination by Mr. G. W. Tryon of Philadelphia, who received it from Mr. C. R. Orcutt of San Diego, Cal. It was collected near that place on a stony bottom, where other bivalves are found in their season, and which appears to be nearly dry at low water. Other specimens were received direct from Mr. Orcutt, who collected about fifty. This animal is a pelecypod or lamellibranch with an *internal shell*. Nothing of the sort, or in the least approaching it, has ever been described.

The animal, from the collector's drawings, is, when living, somewhat of the shape of a small globose Cypraea, of inflated ovoid form, translucent, jelly-like, dotted above with small, rounded papillae, which appear of an opaque white on the general translucent ground. When living, Mr. Orcutt states, it was over an inch in length. The specimens sent have been contracted by alcohol to less than half an inch in length. The mantle which covers the dome of the body is tough and thick: the sides are smooth, and nearly free from papillae. The superior median line is a little depressed. The basal part of the anterior end in life is prolonged beyond the general mass in a wide trough, with the convexity upward, and somewhat expanded at its anterior extremity. About one-third of the way from the anterior end, the mantle is perforated by an orifice, which pierces it in the vicinity of the mouth. The edges of this orifice project from the general surface, and it is lined with close-set, small papillae. At about the same distance from the posterior end is another tubular perforation, holding a similar relation to the anus; which has, however, plain edges, and is not internally papillose.

Turning the animal over, we find the anterior trough of the mantle prolonged backward, like a slit with plain edges, to about the posterior third; from this projects a narrow, hatchet-shaped foot, with a strongly marked byssus-gland at its posterior angle; from this a bunch of white byssus extends to the stone or other object to which this mollusk attaches itself. The cavity of the mantle extends some distance behind the commissure of the pedal opening. The anterior point of the foot is roofed by the trough-like expansion above mentioned. The mouth is provided with two pairs of small palpi. Two gills, very finely microscopically laminate, extend backward from near the mouth, on each side, to the posterior end of the body, the wider one being the inner: between their posterior ends a thin reticularly perforate veil connects the two pairs, and shuts off the anal area from the rest of the mantle cavity. The intestine contains a hyaline stylet, and is considerably convoluted; but the viscera offer no marked peculiarities when compared with ordinary pelecypods. The shells are enclosed in two little sacs in the substance of the mantle. The umbones are near together, apparently connected by a brown gristle resembling an abortive ligament, and are nearly over the heart. The valves are about ten millimetres long and one millimetre wide, destitute of epidermis, prismatic, or pearly layers. There are no muscular or pallial impressions, no adductors, hinge, or teeth. They resemble in form the exterior of Gervillia, as figured by Woodward, and are pure white. As they lie in the body, they diverge at a rather wide angle from the beaks, forward. The embryonic valves are retained like two tiny bubbles on the umbones.

Under as recent a classification as that adopted by Lankester, in the new edition of the Encyclopaedia Britannica, this creature would form a new order, Amyaria, as opposed to the old Mono- and Dimy-aria. These orders being pretty generally given up, though not yet out of the text-books, it is probable that no others can yet be formulated. Whatever be its relations to the higher groups, a point to be determined by further study, there can be no doubt that the animal forms the type of a new family, Chlamydoconchae, and may take the name of Chlamydoconcha Orcutti. It is evident already, that the genus does nothing toward bridging the gap between the gastropods and pelecypods, but is simply a remarkably aberrant form of the latter group, and probably derived from some form with an external shell. It is able, according to Mr. Orcutt, by sphincter-like contractions of the mantle, to produce currents of water over the gills, which are probably finally ejected by the anal tube.

A paper on the subject, with figures, will be published shortly.

WM. H. DALL.

Time without instruments.

Students usually feel little interest in the method of time in astronomy by 'a single altitude of the sun,' because they do not expect to own an instrument with which to measure the altitude. They can easily make the apparatus described below, by which, with careful handling, time may be found with a probable error of fifteen seconds.

Frame together the three pieces AB, AC, and DE, at right angles, — AB about sixty inches, AC eighteen inches and a half, and DE ten inches long, and each an inch and a quarter square. Cut a half-inch slit, one inch deep, in the end C, and in the direction AB. Fasten a piece of tin one inch square, with a hole an eighth of an inch in diameter, on the right-hand face of AC at C, with its hole opposite the centre of the slit. Set in a bubble at l by which to level AB. Let fall a perpendicular from the hole in the tin plate to AB; and at about twelve inches from the foot of that perpendicular commence the graduation on the centre line AB, dividing into inches and half-inches, and numbering 12, 13, etc., towards B. It will be well to paste a strip of drawing-paper on the face AB, on which to make the graduation.

Measure once for all the exact height in inches of the centre of the hole in the tin plate above the upper face of AB, which should be about eighteen inches, and multiply it by the decimal .9994358, which product designate by h. By using this for the height of AC, all altitudes will be corrected for mean refraction.

To use it, place in the sunlight, — best when the sun is not less than 16° nor more than 45° high, — with AB levelled by the bubble, estimating by eye when AC is perpendicular, so that the bright spot from the hole in the tin shall fall on the graduated centre line of AB. With watch in hand, read the hour, minute, and second when the centre of the elliptical bright spot is exactly on some dividing-line of the scale, and call the scale-reading r: then the sine of the sun's altitude $= \frac{h}{\sqrt{r^2 + h^2}} = \sin a$.

For the hour-angle $= P$, the most convenient formula is, — letting $\delta =$ sun's declination, and $l =$ the latitude of the place, — $\cos P = \frac{\sin a - \sin \delta \sin l}{\cos \delta \cos l}$. This formula, with the known latitude (say, 36° 12′ 45″), may be put in the form

$$\log \cos P = \log \{\sin a - [9.77143] \sin \delta\} + a.\,c.\,\log \cos \delta + 0.09322.$$

A nautical almanac is needed for declination and the equation of time, though tabulated mean values of these for every tenth day of the year will answer for the usual accuracy required in common local time.

The form of apparatus may be varied to suit the taste of the student, or he may use the tin disk with a plumb-line suspended from it, in connection with a straight-edge levelled by a carpenter's level, and these of any lengths he chooses.

Time by 'equal altitudes of the sun' may be found by the same device.

A. H. BUCHANAN.

Cumberland university, Lebanon, Tenn., July 4.

Rotation experiments on germinating plants.

The opposite growth of the root and stem of a germinating plantlet, under other influences than that of gravity, we have recently shown by the following experiments. A circular trough (seen in section, $b\ b$, fig. 1) some sixteen inches in diameter and three

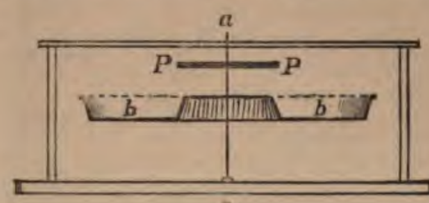
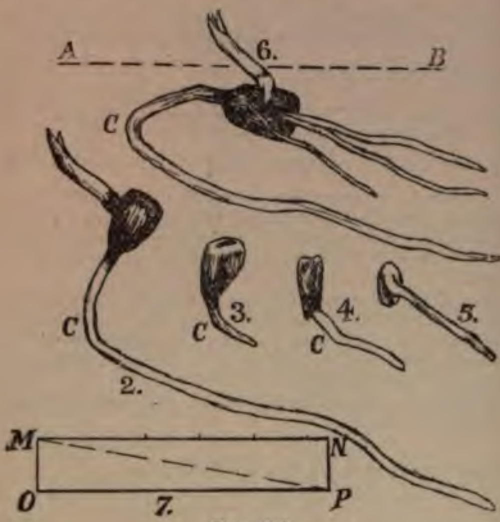


FIG. 1.

deep, rotates about the vertical axis $a\ a$. The trough, closely filled with earth, was planted with a quantity of well-soaked beans and seed-corn, and the whole covered with the fine gauze represented by the dotted lines. Forty-eight hours were allowed for the seeds to begin their growth, before the trough was started in rotation. By means of a Tuerk's motor, a uniform and continuous motion, at the rate of one hundred and eighty revolutions per minute, was then maintained for four days. At the end of this time the earth was carefully removed, and the positions of the young plants precisely noted. It was universally observed that the stems were accurately directed towards the axis, and the roots towards the circumference, of the trough. Figs. 2–6 represent several specimens. $A\ B$ is the horizontal, A being towards axis, and B towards circumference; those of figs. 2, 5, and 6, were at a radius of six inches from axis; figs. 3 and 4 had radii of five and four inches. The curves at the points C, C, C, C, are quite significant, being the points to which the radicals had extended before

rotation commenced. The direction of the stems can be well seen in figs. 6 and 2.

The cause of this mode of growth being, of course, the outward radial tendency of the plantlet in reaction upon the centripetal force acting through the



FIGS. 2-7.

soil, we may put the intensity of the new modifier equal to the centripetal acceleration, $\left(\frac{2\pi}{T}\right)^2 r$. This gives a centrifugal 'force,' so called, of 5,348 degrees, or 5.4 g, at a radius of six inches. If we put $M\,O$ (fig. 7) equal to gravity, and $M\,N$ equal to this centrifugal 'force,' then, for an ideal case, $M\ P$ will represent the resultant direction of the growing rootlet. This is but very loosely approximate to the observed positions, as might be expected.

CHAS. S. SLICHTER.

North-western university, Evanston, Ill., June 27.

Perforations in wool fibre.

In my investigations in wool fibre I have found some defective hairs that were perforated in places, evidently while growing on the sheep's back. As the perforations are perfectly circular, it would indicate that they are made by some creature at present unknown. Would it not be worth the while of some of your scientific readers to examine into the matter, and discover, if possible, what the perforator may be, and whether it is likely to remain as little injurious as at present?

JOS. M. WADE.

Boston, July 7.

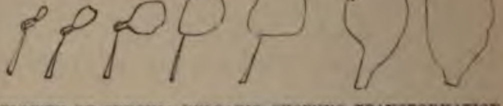
The evolution of petals.

In Mr. Grant Allen's interesting treatise on the 'colors of flowers,' the first chapter deals with the evolution of petals from stamens, in which the author shows that petals are but specialized stamens set apart for the purpose of attracting insects. His proofs are such that no candid reader is likely to finish the chapter, and apply its principles to the flowers he meets in his every-day walks, without being convinced of the correctness of the author's views. The gradual development from stamen to petal can be seen in most of those cultivated flowers which exhibit a tendency to become double, as well as in those which have already become so.

But it would seem that Mr. Allen had overlooked one point in the method of evolution. Throughout the entire book the idea is given that the process of evolution begins by the *filaments* becoming flattened. Thus, on p. 11, taking the English water-lily (Nymphea alba) as a typical example, the author says, —

"In the centre of the flower we find stamens of the ordinary sort, with rounded stalks or filaments, and long, yellow anthers full of pollen at the end of each; then, as we move outward, we find the filaments growing flatter and broader, and the pollen-sacs less and less perfect; next we find a few stamens which look exactly like petals, only that they have two abortive anthers stuck awkwardly to their summits; and finally we find true petals, broad and flat, and without any trace of the anthers at all. Here, in this very ancient though largely modified flower, we have stereotyped for us, as it were, the mode in which stamens were first developed into petals, under stress of insect selection."

Again, on p. 115, he says, "It has been objected by two or three authoritative critics, that the original petals need not have been yellow, because they represent the flattened filaments, *not the anthers*;" and the author goes on to show that filaments are usually of the same color as the petals.



FLOWER OF CYDONIA VULGARIS, SHOWING TRANSFORMATION OF STAMENS TO PETALS.

An examination of a number of our common flowers shows, that, in many cases at least, the evolution of the petal begins with the *anther* rather than the filament. Thus, in the common quince (Cydonia vulgaris), many of the flowers possess stamens of which the anthers have become petaloid, while the filaments are of the normal type. Some of the anthers are merely flattened on one end; others are more so; while in others the anther has become a flat, white, petaloid disk on the end of a normal filament. From this, every gradation can be seen to the normal petal. In this instance, not only the pollen-walls, but the pollen itself, has become petaloid before the filament has been at all modified. In the flowers of the mock-orange (Philadelphus coronarius) the same transition often occurs, as well as in many of the double flowers of our gardens and conservatories.

CLARENCE M. WEED.

Agricultural college, Lansing, Mich.

Metallic circuits in cables.

When the full text of Mr. Gisborne's paper, read before the Royal society of Canada, is published, it will be shown that his anti-induction experiments with all metallic circuits in underground cables were made in connection with an electric target, for which a prize medal was awarded to him at the London exposition of 1862; and the diagrams attached to his paper will also explain why parallel metallic circuits in a *multiple* cable, unless twisted according to his design, will *not* eliminate induction of currents in

neighboring circuits. Submarine metallic circuits, both insulated and *uninsulated*, and operated upon the open-circuit system, were also experimented upon by Mr. Gisborne, in conjunction with the late Hon. F. O. J. Smith of Maine, during 1858–59, all of these experiments being upon record. D. H. K.

Too big to swallow.

Some young men standing on the shore of the Mississippi, June 27, near this place, saw something singular on the water. On going out to it with a boat, they captured it, and it proved to be a catfish with a land-tortoise in its mouth. The fish weighed a little less than twenty pounds. The turtle was about five inches across the back. It was fast within the jaws of the fish, requiring considerable force to extricate it. It was dead. The fish was in a demoralized condition, allowing itself to be captured with the hands.

P. J. FARNSWORTH.

Clinton, Io., July 3.

The gyration of a vibrating pendulum.

Referring to Mr. Hendricks's note on the gyration of a vibrating pendulum, in which reference is made to one of my statements, I wish to state that in the original paper the expression of τ by oversight was

$$\tau = \sec\theta \times \text{one day}.$$

The error was discovered soon after printing. When this was corrected in the reprint, it was not observed that it would make the sentence quoted by Mr. Hendricks state what was never intended.

W. FERREL.

HIGHER EDUCATION AND THE MASSES.

A POPULAR fallacy in respect to the worth of the higher education has rarely been so clearly put as it is by that master of fallacies, Gen. Benjamin F. Butler. In his recent response to an invitation from the National educational assocation to attend the convention in Madison, Wis., he says, "The higher education of the few mainly affects themselves; but *the education of the masses, which shall leaven the whole lump*, is the foundation upon which the permanency of our government must rest at last." In other words, Gen. Butler asserts that it is the dough, and not the yeast, which acts as the leaven.

Every intelligent patriot is in favor of popular education, but who are to be the teachers of the people? Gen. Butler replies, "It is the education of the masses which shall leaven the lump." The boy is to lift himself over the fence by pulling at the straps of his boots.

It is not even true in politics that the masses leaven the lump: it is the men of intellect who instruct and persuade and incite the multitudes to united action. In literature and science it is quite as absurd to say that "the higher education of the few mainly affects themselves." A doctrine more fatal to the progress of knowledge, or more pernicious to the welfare of the people, could hardly be uttered by an intellectual demagogue. Did the higher education of Plato, Aristotle, Euclid, Pliny, 'mainly affect themselves'? Did the higher education of Homer, Dante, Virgil, Shakspeare, 'mainly affect themselves'? How was it with Columbus, Luther, Newton, Bacon, Faraday, — did their higher education 'mainly affect themselves'? For whose benefit all the researches of Pasteur and Koch, — 'mainly themselves'?

If Gen. Butler were alone in cherishing the fallacy that advanced education is a luxury, which pleases a few impracticable souls, and does no good to the masses, his words might pass unnoticed by *Science;* but this deceptive doctrine sways many, even, of those who are devoted to teaching. It crops out in educational conventions and in educational journals. The fallacy should be pointed out whenever it is uttered. The progress of the masses, the improvement of any age or any people, depends upon great men; great men are nurtured by great ideas; great ideas are developed by higher education, — the education which goes beyond that which is obvious to the abstract and fundamental, — the education which raises hard questions in respect to the unknown, and proceeds to seek the answer, confident that the discovery of every great truth will sooner or later contribute to the welfare of mankind.

This is an education which does not mainly affect the few and cultivated: it elevates the masses. If this truth should ever become clearly understood by our countrymen, they will do as much for higher education as they have done for popular instruction; and a happy day it will be for American civilization. Universities and schools of science will flourish as they have never done before; the government will be served by men who know, and not by men who guess; the public health, intelligence, morality, and prosperity will all be promoted.

THE AMERICAN INITIATIVE IN METHODS OF DEEP-SEA DREDGING.

THE published records respecting the use of dredges for natural-history purposes carry us back to scarcely more than a century and a quarter ago, when Otho Frederick Müller, a prominent Danish naturalist, began his studies of the aquatic life inhabiting the coasts of Norway and Denmark below the shore-level. The dredge he used, a very simple affair, was, so far as we know, the first one ever devised for the special needs of the naturalist; and yet, with only a single important modification, as to the shape of the frame, it has been handed down to our time as the most efficient appliance for the ordinary purposes of dredging.

As described and figured in 1779, it consisted of a plain rectangular iron frame, with all four sides of equal length, and bevelled to sharp edges in front, forming the mouth-piece to a large and open net. Four handles extended forward from the angles, and met in a single ring for the attachment of the drag-rope. The principal defect of this dredge consisted in its very wide mouth, permitting the easy escape of specimens, both while dragging and during the hauling-in.

Although Müller's researches were confined to shallow water, apparently not exceeding a depth of thirty fathoms, they established a precedent for subsequent operations, and afforded proof of the value of submarine collecting.

This new field of exploration did not, however, begin to enlist the active services of working naturalists to any extent until about the third or fourth decade of the present century, since which time the interest in marine zoölogical research has rapidly increased, and our knowledge of the sea-bottom has been extended to the deepest known areas. For the first thirty or forty years, the improvement in methods of work scarcely kept pace with the progress of knowledge regarding the inhabitants of the sea; and it is only within the past fifteen years that the methods of deep-sea dredging have been at all perfected.

To Dr. Robert Ball of Dublin, who was afterwards associated with Professor Edward Forbes in his memorable explorations, has generally been given the credit of having devised, about 1838, the improved form of naturalists' dredge, in nearly the same shape in which it is used to-day. However that may be, it was about the year last mentioned that both European and American naturalists entered actively into the study of the sea-bottom; and the history of their various exploits down to the present time affords an exceedingly interesting chapter upon which the subject of our paper permits us to touch but slightly.

It may be well to remark, however, that the character and results of European, and especially British, exploration are much more widely and popularly known than are those of our own country. The reason is obvious. The active mercantile pursuits of a young and progressive people have naturally made them less appreciative of scientific facts and results than the inhabitants of many older countries, where business interests have fewer claims upon all classes. There has been but a slight demand for popular writings upon such an unpractical subject, and the plodding naturalist has generally been content to record his observations and methods where they were accessible only to his brother-workers. For this reason, American naturalists have not received the credit which is their due, either at home or abroad; and much of the honor that justly belongs to them has passed into other hands.

So far as concerns the general public, this is not to be wondered at, when we consider that the only popular accounts of deep-sea dredging explorations obtainable in this country are of English origin. But the same excuse does not hold good for the working naturalists of any country, including our own; as the progress of American deep-sea research, and the improvements in methods for carrying it on, have in nearly all instances been duly and promptly recorded in the proper channels to insure wide and timely distribution.

Since the very beginning of activity in this branch of investigation, American workers have not been far behind those of any European country; and their record is as creditable. Dredging was carried on by the Wilkes U. S. exploring expedition during the early part of its cruise, beginning in 1838; and at about this same time a few of our most earnest naturalists were using the dredge at home. The late Dr. William Stimpson, one of the most intelligent observers in this branch, and whose name is closely linked with several important explorations, began his career in Boston harbor between 1848 and 1850; his first instructions having been received from Dr. W. O. Ayres, who began dredging fully ten years before. Stimpson's researches were largely conducted under government auspices; and the collection of submarine specimens resulting from his labors, distributed over many portions of the Atlantic and Pacific Oceans, was probably one of the very largest of its kind that had been made, up to the time of its unfortunate destruc-

tion by fire at Chicago, in 1871. The loss of these collections, and of all the voluminous manuscript reports treating of them, followed by the sad death of the author, has deprived our country of a most important chapter in the history of submarine exploration.

The sixth decade of this century, however, brought out many additional investigators; and a fresh impetus was given to the work, which has since been expanded and developed to such an extent as to establish, beyond all question, American precedence in the methods of deep-sea research at least, both as regards dredging and sounding.

From among the more energetic and successful of our modern dredgers may be mentioned Prof. A. E. Verrill of Yale college, whose dredging studies began in 1864, on the coast of Maine, and who, since the organization of the U. S. fish-commission, has been its main helper and adviser in all matters pertaining to submarine research, the special direction of the dredging operations having been intrusted to him from the beginning. His earlier experiences gave him a clear insight into the requirements of the new project, and enabled him to devise many valuable appliances, and improve upon those which had been in use. To his zealous and untiring efforts is due much of the perfection in present methods of work.

In 1867 Mr. L. F. de Pourtalès, of the U.S. coast-survey, began the extensive series of deep-sea explorations off the southern coast of the United States, which were carried on for several years, and subsequently led to the eventful cruises of the steamer Blake between 1877 and 1880, resulting in an entire revolution in the methods of deep-sea dredging and sounding. The investigations of Mr. Pourtalès anticipated, by a year, those of the English steamers Lightning and Porcupine, which have been so widely described, and were preceded by only one series of systematic dredgings in equal depths of water, — those of the Professors Sars, father and son, of Norway. But little credit for this fact has been received from naturalists abroad; the date of Mr. Pourtalès' first cruise being generally regarded by them as 1868, although his first paper, descriptive of the character of his work, and of many new forms of deep-sea animals, appeared in December, 1867.[1] His collections, representing principally the fauna of the Gulf Stream off Florida, gave new and interesting results; going farther to prove the existence of a rich and diversified deep-sea fauna, different from that of the shore regions, than any previously obtained.

[1] *Bulletin Mus. comp. zoöl. Cambridge*, vol. i., 1863–69, pp. 103–120.

That these dredgings were not undertaken to please the passing whim of some over-enthusiastic naturalist, but were as deliberately planned and carried out, and as successful in their results, as those of the English steamers which followed them in conception, a reference to the official publications of the coast-survey will sufficiently prove. As substantiating this statement, we may be pardoned for quoting a short paragraph from the report of Mr. Pourtalès, above referred to (December, 1867), in which the plans and objects of the new explorations are briefly stated. This would not be called for, were it not that it is this identical report which has been so utterly ignored by European writers, and equally overlooked by many American. Had it only been written in popular language, and been published with copious illustrations, it might have received the credit which has been denied it; but such channels of publication are seldom deemed necessary to establish priority in scientific research.

The plan of operations, according to Mr. Pourtalès, was as follows: —

"The present superintendent of the coast-survey, Prof. B. Peirce, has lately directed the resumption of the investigations of the Gulf Stream, so successfully inaugurated by his predecessor, but interrupted for several years by the war. Besides observations of the depth, velocity, and direction of that current, and the temperature and density of the water at different depths, the researches will be extended to the fauna of the bottom, of the surface, and of the intervening depths. Not only will an insight be thus obtained into a world scarcely known heretofore, but that knowledge will have a direct bearing on many of the phenomena of that great current. Thus a new light may be thrown on its powers of transportation from shallow to deeper water or along its bed, on its action in forming deposits in particular localities, or on its possible influence on the growth of coral-reefs on its shores."

In a subsequent passage, he summarizes his first season's results in the following terse remarks, the italics being his own: —

"However, short as the season's work was, and few as were the casts of the dredge, the highly interesting fact was disclosed, that *animal life exists at great depths, in as great a diversity and as great an abundance as in shallow water.*"

Early in the following year (1868) the same

explorations were resumed, and they were continued through 1869.

It may be thought that we have departed too widely from our subject in discussing with so much detail the progress of American research during a period in which no great improvements were made in methods of work on this side of the Atlantic; but how could we have better furnished proof of the rapid growth of interest in such matters, and of the maturing of ideas which prepared the way for the important changes marking the next decade?

There is, however, one noteworthy addition to the collector's outfit made in this period, which deserves special mention. On one of the dredging cruises of the English exploring steamer Porcupine, between 1868 and 1870, Capt. Calver, the naval officer in charge, attached several of the common deck-swabs to the end of the dredge-net, with the expectation, that, in sweeping the ocean-bottom, they would securely entangle all the rough and spiny objects lying loose within their path. His fondest hopes were realized; and the novel experiment, suggested by often finding such objects as sea-urchins, corals, and sponges, adhering to the exterior of the dredge-net, and even to the lower part of the drag-rope, gave origin to one of the most efficient implements of modern deep-sea research.

When the beam-trawl, a well-known English appliance for the capture of bottom-fish, was first adopted into the outfit of the marine zoölogist, we are unable to state; but it does not appear to have ever been extensively and systematically employed in scientific research until so used by the U. S. fish-commission, beginning in 1872. It was afterwards used by the Challenger from 1873 to 1878, and now greatly excels the dredge in the extent and value of its results, wherever the ground is suited to its use.

The year 1871 was signalized by the organization of the U. S. fish-commission, one of the most important scientific establishments of modern times for marine zoölogical work. Although instituted primarily for the investigation of fishery matters, it has, through the wise and liberal policy of its director, Professor Baird, accomplished most valuable results for marine biology. The latter department has been sedulously fostered, in the belief that its results would have an important bearing upon the practical questions at issue. No pains have been spared to perfect the methods of research, and many valuable contributions have already been made to the marine collector's outfit. These are briefly described below; and, as the history of the commission is already well known to most readers, we need refer here to only a few points which have marked its progress.

The earlier explorations were carried on mainly by means of sail-boats, and were confined to comparatively shallow water. From 1873 to 1879 a naval tug was placed at the disposal of the commission every year; but in 1880 the steamer Fish Hawk, a twin-screw propeller of two hundred and five tons (*n.m.*), was built expressly for the combined purposes of fish hatching and dredging. Its small size and light draught prevented long trips at sea; but it was well adapted for deep-sea work, and was supplied with all the improved appliances, as well as those which had originated with the commission, including wire rope, then recently introduced by the coast-survey. In 1883 the steamer Albatross, described in vol. ii. of *Science* (pp. 6, 66), was completed, and made her first successful cruise in the spring of that year. Her log for the summer of 1883 records the deepest trawling yet made in the Atlantic Ocean; the depth having been 2,949 fathoms, and the results successful. Brief accounts of her dredging cruises under Lieut.-Commander Tanner, U.S.N., have appeared from time to time in late numbers of *Science*.

While the fish-commission claims priority for many improvements in apparatus primarily intended for depths under a thousand fathoms, it willingly yields the palm for deep-sea improvements to the U. S. coast-survey, especially in the persons of Commander Sigsbee, U.S.N., and Mr. Agassiz. The explorations of the steamer Blake from 1877 to 1880, in which the methods of deep-sea dredging and sounding were completely revolutionized, mark one of the most important stages in the progress of marine research. Wire rope was substituted for hemp, the dredge was altered to adapt it to the soft bottoms of deep water, on which dredging results had always been uncertain, and the beam-trawl was made reversible. The methods of handling and reeling the rope were also perfected. These changes and additions were briefly described and figured from time to time, as work progressed, in the Bulletin of the Museum of comparative zoölogy, at Cambridge, by Mr. Agassiz and Mr. Sigsbee, and were afterwards fully discussed by the latter in one of the most elaborate and instructive reports ever dedicated to the methods of deep-sea research.[1] It is a quarto volume of two

[1] Deep-sea sounding and dredging: a description and discussion of the methods and appliances used on board the coast and geodetic survey steamer Blake. By Charles D. Sigsbee, lieutenant-commander U.S. navy, assistant on the coast and geodetic survey. Washington, 1880.

hundred and eight pages and forty-one plates, describing the sounding and dredging appliances used by the Blake, and which, for the greater part, were devised or improved during her dredging cruise. So far as her dredging appliances are concerned, the credit for changes made belongs mostly to Mr. Sigsbee and Mr. Agassiz; the former having been in command of the expedition, and the latter in charge of the natural-history operations.

During the seventh decade, European explorers were not idle, and numerous deep-sea expeditions were fitted out. Most notable among these was the cruise of the British ship Challenger around the world between 1873 and 1878. Her scientific results were most interesting; but the older methods of deep-sea work were not greatly altered, although the practicability of using the beam-trawl successfully in the deepest water was fully demonstrated.

In 1881 the French government inaugurated a series of submarine explorations in the Atlantic Ocean and Mediterranean Sea; for that purpose fitting out a small naval vessel, the Travailleur, and placing the management of affairs in the hands of a competent scientific staff, under the directorship of Prof. A. Milne-Edwards. These investigations were continued by the same vessel during 1882, the appliances and methods of work having apparently been patterned after those generally recognized in Europe. In 1883 a larger vessel, the Talisman, was assigned to the work, and operations were established on a much grander scale than before.

For an account of these explorations, descriptive of the methods of work and general results, we are indebted to the last volume of *La Nature*, a French journal of the character of *Science*, which began in a January number the publication of a series of articles by one of the naturalists who accompanied the steamer.[1] Coming from such an authoritative source, we are led to regard these papers almost in the light of a semi-official report, and look to them for at least a correct statement regarding the origin of their methods of work, inasmuch as these matters are discussed in some detail, and with evident pride at the completeness of the outfit. That the outfit was complete, no one who is at all posted on the subject can deny; for nearly all of the many improvements introduced by the coast-survey and fish-commission prior to 1880 are most faithfully copied, and most heartily praised for their perfect adaptation to the requirements of research.

We glance through the several pages of the report for at least some slight acknowledgment on behalf of American inventive skill; but beyond a brief statement to the effect that the hoisting-engine "was of the same type as that employed by Mr. Agassiz," and that he also "used with good results the common form of beam-trawl," we are left to infer that the entire outfit was of French origin; and such must be the impression of every one who reads these papers. In fact, in several instances, credit is explicitly bestowed on French inventors for certain of the appliances which do not differ in any essential features from the corresponding American patterns.

What is to be gained by thus appropriating to the credit of a nation what properly belongs to another and a friendly one, by all the rights of international courtesy, it is difficult to understand, and especially so in this age of supposed enlightenment, when every important discovery is carried with lightning rapidity to all parts of the civilized world. The field of marine research is sufficiently broad to engage the entire attention of all the naturalists who have yet entered it; and the frequent manifestations of jealousy on the part of foreign, and especially French investigators, which often result in wholly ignoring the works of an able American author, can but retard progress instead of aiding it.

Proofs of the superior excellence of American methods of deep-sea research may be found in every important scientific library of Europe as well as this country; and at the two most prominent international fisheries exhibitions of the world, — those of Berlin in 1880, and London in 1883, — all of the American appliances were displayed, and received the highest awards. They have therefore been made sufficiently well known to establish their merits before the scientific world; but, as no descriptions of them have yet been published for the benefit of the general public, we propose in future numbers of *Science* to give accounts of their construction, and of the causes which lead to their introduction.

RICHARD RATHBUN.

[1] For an abstract of the portion relating to the apparatus employed, see *Science*, No. 62.

SPECIAL MANURES FOR PARTICULAR CROPS.

THE fact that the percentages of nitrogen and of the several ash ingredients vary quite widely in different plants (legumes being rich in nitrogen, cere-

als in phosphoric acid, and root-crops in potash) has frequently led to the compounding of so-called special fertilizers or manures, intended to be particularly adapted to the growth of certain crops. The starting-point in the preparation of such fertilizers has usually been Liebig's 'restitution theory' (*ersatzlehre*), according to which the soil must be manured with the same quantities of fertilizing materials as are removed by the crops produced. On this theory, a special manure for beans would contain much nitrogen, and one for corn or wheat much phosphoric acid. Such special manures were first brought prominently into notice in this country by Professor Stockbridge of the Massachusetts agricultural college, and, for the last few years, have enjoyed great popularity, almost every prominent fertilizer-manufacturer producing fertilizers for all conceivable crops, even to orange-trees. These fertilizers have seldom had the same composition in two successive years; and those of each maker have differed from those of every other, thus affording to consumers an abundant variety from which to choose.

It is not proposed here to enter into a consideration of all the numerous fallacies involved in the use of special manures, but only to present the results of some recent experiments, which have an important bearing upon the fundamental idea of such fertilizers. This idea is, in brief, that crops must be manured most abundantly with those elements which they contain most abundantly. There are not wanting, however, indications that this is not altogether true. For example: wheat contains, on the average, about half as much nitrogen as clover; yet experience has shown that wheat is greatly benefited by nitrogenous manures, while clover is comparatively indifferent to them. Indeed, it is a common practice to grow wheat after clover, using the latter crop to gather nitrogen for the former. Many other similar cases might be cited; and it is a noteworthy fact that many special manures, while professing to be compounded on the theory stated above, are, in fact, modified to correspond with these teachings of experience.

All this suggests that one important factor in determining the most suitable manuring for any crop is the power which that crop has of gathering its supplies from natural sources. Paul Wagner has recently published[1] some investigations upon this subject, which are interesting, both in themselves and in their suggestions for future work. He compared peas and barley, growing them in zinc vessels twenty-five centimetres high and twenty-five centimetres in diameter. These vessels were uniformly filled with carefully mixed and sifted soil, were provided with a constant water-supply, and, in short, differed only in the manuring which they received.

The following manurings were given in each series: No. 1, nothing; No. 2, nitrogen; No. 3, potash; No. 4, phosphoric acid; No. 5, phosphoric acid and nitrogen; No. 6, nitrogen and potash; No. 7, potash and phosphoric acid; No. 8, potash, nitrogen, and phosphoric acid. Each manuring was duplicated, so that thirty-two vessels were used in all. Nitrogen was given in every case at the rate of 40 kilos per hectare, in the form of nitrate of soda; potash, at the rate of 80 kilos per hectare, in the form of chloride; phosphoric acid, at the rate of 100 kilos per hectare, in the form of superphosphate. The duplicate manurings gave reasonably accordant results, and the author estimates the limits of error at 3% of the total yield. The following table shows the *relative* yield of total air-dry matter (grain and straw), that of the unmanured vessels being taken as 100.

No.	Manuring.	Crop.	
		Peas.	Barley.
1	Nothing	100	100
2	Nitrogen	104	113
3	Potash	100	107
4	Phosphoric acid	126	113
5	Phosphoric acid and nitrogen	132	146
6	Nitrogen and potash	102	121
7	Potash and phosphoric acid	147	126
8	Potash, phosphoric acid, and nitrogen,	151	181

A study of these figures, remembering that differences of three or four per cent have no significance, leads to the following conclusions: —

The nitrogen had as good as no effect upon the peas (compare 1 with 2, 3 with 6, 4 with 5, and 7 with 8: the greatest difference is 6%). The same comparison for the barley shows that the nitrogen here had a very beneficial effect, the increase in the crop amounting to from 13% (nitrogen alone) to 55% (nitrogen in combination with potash and phosphoric acid). Interesting differences in the effect of potash and of phosphoric acid upon the two plants are also evident, but we pass over these for the present.

The nitrogen of the unmanured soil amounted to 13.77 grams in each vessel; that of the manuring, to 0.2 of a gram. The nitrogen of the unmanured soil was fully sufficient to supply the needs of the peas, as the following considerations show. There were produced —

	Dry matter.	Containing nitrogen.
Without manure	30.0 grams.	0.91 grams.
With nitrogen	31.3 "	0.95 "
With potash and phosphoric acid,	44.0 "	1.34 "
With potash, phosphoric acid, and nitrogen	45.2 "	1.37 "

That is to say, manuring with potash and phosphoric acid enabled the peas to produce 47% more dry matter, the 0.43 of a gram of nitrogen necessary for this increase being obtained as readily from the comparatively insoluble nitrogen of the soil as from the soluble nitrogen added as manure.

For the production of barley, the figures stand as follows: —

[1] *Landw. Jahrbücher*, xii. 717.

	Dry matter.	Containing nitrogen.
Without manure	13.5 grams.	0.23 grams.
With nitrogen	15.3 "	0.26 "
With potash and phosphoric acid,	17.0 "	0.29 "
With potash, phosphoric acid, and nitrogen	24.4 "	0.41 "

The nitrogen of the unmanured soil was not sufficient to fully supply the needs of the barley; for while manuring with potash and phosphoric acid only enabled it to produce 26% more dry matter, containing 0.06 of a gram of nitrogen, the addition of 0.2 of a gram of soluble nitrogen enabled it to show an increase of 81% of dry matter, containing 0.18 of a gram of nitrogen.

These facts admit of but one conclusion; viz., that peas are able to assimilate the nitrogen contained in the soil much more readily than is barley. The fact that the pea-plant contains much more nitrogen than the barley-plant does not show that peas should receive much more nitrogenous manure than barley, but, on the contrary, that they can readily supply themselves with nitrogen, but need to be manured with potash, and particularly with phosphoric acid. Barley, on the other hand, contains little nitrogen, partly because it cannot gather it readily, and therefore it needs an artificial supply. In other words, the greater need of nitrogen on the part of the peas corresponds to a greater power of obtaining it.

It is, of course, unsafe to generalize from these two experiments. At the same time, their results correspond so exactly with the teachings of experience regarding the most suitable manuring for legumes and cereals respectively, and appear *a priori* so probable, that one can hardly avoid a strong belief in their general application. They certainly open an interesting and important field for further research. If it can be shown, that, in manuring any given plant, we ought to direct our attention more particularly to those elements of its food which it contains in relatively small quantity rather than to those present in abundance, we shall have made a very considerable advance in our knowledge of the theory of manures.

H. P. ARMSBY.

KOCH'S WORK UPON TUBERCULOSIS, AND THE PRESENT CONDITION OF THE QUESTION.

THE question of the cause of that form of disease known as tuberculosis is one which has been the subject of discussion in medical circles for many years. It is of especial interest to the laity, because in one of its forms it includes the affection so widely known as consumption of the lungs, or phthisis. The idea of a contagious nature as belonging to this process, i.e., to tuberculosis, was first broached in modern times by Villemin,[1] as the result of a series of experiments upon animals, conducted by him. These experiments attracted very great attention at the time, and were subsequently repeated, with varying degrees of success and failure, by numerous observers. Twenty-five years before Villemin's experiments were announced, Klencke [1] claimed to have produced tuberculosis in animals (rabbits) by the inoculation of tuberculous matter. His results do not, however, seem to have received the attention which they deserved; and it is to Villemin that is usually ascribed the beginning of the line of experiment which has resulted in the work which is under consideration to-day.

Among those who have taken up the question of the specific nature of tuberculosis in inoculation experiments, may be especially mentioned Waldenburg, Klebs, Cohnheim, Fränkel, and Baumgarten. Inhalation experiments, in which the disease is sought to be communicated by forcing animals to inhale finely divided dried tuberculous materials, have been tried again and again with as conflicting results as in the preceding series. Those who have done the most noteworthy work in this direction are Schottelius, Tappeiner, Weigert, Weichselbaum, and Balogh.

Feeding-experiments form the third class by which an endeavor to obtain evidence for or against the specific nature of tuberculosis has been made. It is unnecessary to do more than mention the names of a few of those who have taken a prominent part in this branch of the investigation: such are Aufrecht, Klebs, Bollinger, Colin, Tappeiner, and Toussaint.

These names, forming but a small part of the catalogue of those who have been interested in the study of tuberculosis, will give some indication of the vast amount of work done, and the interest taken in this subject.

After Villemin's experiments, and coincident with all the work that was called out by them, the question of the *nature* of the virus of tuberculosis was eagerly discussed. The idea of a *contagium vivum* was first suggested by Buhl,[2] who claimed to have observed micro-organisms constantly occurring in tuberculous nodules; these micro-organisms being both micrococci and bacteria. This idea was taken up by Klebs,[3] who claimed to have isolated a micrococcus by culture, and to have produced tuberculosis by the inoculation of this organism. Klebs's experiments were repeated, and with the same, or nearly the same, successful results, by Schneller,[4] Reinstadler,[5] and Deutschmann.[6] The acceptance of this monas tuberculosum, as it was called, as the specific cause of the tuberculous process, was not general, however; and for various reasons the work of Klebs seems to be untrustworthy.

[1] *Gazette médicale de Paris*, December, 1865. Études sur la tuberculose. Paris, 1868.

[1] Untersuchungen un erfahrungen, etc. Von Professor KLENCKE. Leipzig, 1843. Bd. i.

[2] Lungenentzundung, tuberculose, und schwindsucht, 1873.

[3] *Prager med. wochenschrift*, 1877, Nos. 42 and 43.

[4] *Ueber therapeutische versuche. Arch. für exp. pathol.*, bd. xi., 1879. *Exp. und histolog. untersuchung über die entstehung der tuberculose, etc.*, 1880.

[5] *Arch. für exp. pathol.*, bd. xi., 1879.

[6] *Med. centralblatt*, No. 18, 1881.

While all these investigations were going on, and the contradictory and conflicting results derived from them were being given to the world, other experiments were being conducted, the results of which were not announced as the work progressed, but were kept from publication until they had been verified in the most complete manner that modern methods would permit. These experiments were those of Robert Koch, conducted by him at the laboratory of the German board of health in Berlin, and pursued with unremitting diligence and care for over two years. The results were first made public under the modest title of 'The etiology of tuberculosis,' at a meeting of the Berlin physiological society in March, 1882, and were published in the *Berliner klinische wochenschrift*, 1882, No. 15. His method of work was as follows: —

Starting with the assumption that a micro-organism might be at the bottom of the disease, he carefully searched for some evidence to support this theory by microscopic investigation of large numbers of tuberculous tissues from various sources. As a result, he found, that with favorable illumination of the specimen, and good lenses, it was possible to make out the almost constant presence, in tuberculous tissues, of a rod-like organism much smaller and finer than most of those that had hitherto been observed. The occurrence of this organism was found to be so frequent, and in such early stages of the disease, that a suspicion of its causal relation to the pathological process was forced upon him.

The discovery of the existence of this bacterium was but the beginning of the investigation, however; and the masterly series of experiments by which he went on to prove its specific relationship must be read to be appreciated.

In the first place, it was necessary to isolate this organism from its surroundings, and to propagate it by itself; that is, to produce a 'pure culture.' The best means to do this could only be ascertained by experiment; and, after the conclusion of these experiments, his results were these. The organism was found to flourish best at a temperature of from 36° to 40° C., — a much higher range than is necessary for most forms of bacteria. This being ascertained, it was necessary to find some suitable culture-soil upon which the organism could flourish; for the ordinary gelatine media would not remain solid at this temperature. Here it was found that the serum of the blood of sheep or cattle was the best medium to be employed; for, by exposure to a comparatively low temperature (65° C.), it would gradually solidify, until, at the end of a few hours of such exposure, it would become a transparent, amber-colored mass of a jelly-like consistency, of course remaining solid at a lower temperature for any length of time. After this was done, there was still another peculiarity of this organism to be appreciated, and that was its slow growth. Up to this time, bacteria were supposed to complete the cycle of their existence in a very short time, — usually measured by minutes, occasionally by hours. In this case, however, there was something entirely different; and it was not until after a large number of experiments had failed, that it was realized that they were dealing with an organism requiring from a week to ten days for any appreciable increase in its numbers to occur.

Having found out all these peculiarities, it remained to study what happened in the culture-apparatus, as time went on. It was found that it required from two to three weeks for such a growth to take place upon the surface of the culture-medium; that a portion could be transferred to another nutritive soil, and a new culture started: it was found that the growth occurred in dry, whitish-gray scales, that, under a low power of the microscope, were seen to be rather of a sigmoid form; and it was found that when these scales were transferred to other soil and broken up, each fragment would produce like scales, and that this method of propagation could be kept up for months at a time. Inoculation of animals of various kinds with material from these cultures at any and all stages of their growth, done under the most rigid precautions for the exclusion of any impurities, or possibly specific matter, was found invariably to produce the disease tuberculosis. The tissues of these animals, when killed, presented the nodular appearances peculiar to the disease; and in these nodules were always found organisms exactly similar to those which had been injected. Cultures of these organisms showed exactly the same peculiarities as in the first instance; and inoculations with the result of these cultures produced the same pathological appearances.

In order to prove that these organisms *alone* would produce the disease, Koch used other substances than tuberculous matter for inoculation; and these substances being proven by microscopic examination to contain no organisms, and being protected from external contamination by all known precautions, gave entirely negative results, and in no case was tuberculosis produced. On the other hand, in no case was there a failure to produce the disease, when materials containing the organism, or the organism itself, were employed as the inoculating material.

Thus it will be seen that the conditions necessary for the establishment of a specific causal relationship between a micro-organism and a given disease were fulfilled in this case, so far as it was possible for one observer to bring them about. The constant occurrence of an organism in the varying forms of the disease in animals and in man; its isolation from the tissues, and reproduction by artificial means; its introduction into healthy animals, with the resulting pathological processes exactly similar to the original disease; its discovery in these inoculated animals; and its re-isolation and observation, — all these requirements have been repeatedly fulfilled in the case of the bacillus of tuberculosis, together with that other trying one, that materials proven to contain no bacilli invariably fail to act in any specific manner.

Not content with the work thus announced, Koch went on for a year longer with his experiments, the results of which were collected in July of last year, but have only recently reached American readers

in the second volume of the German health reports.[1] In this article, Koch re-affirms his original announcement, and gives the results of further work in the same direction, all reached by experiments conducted with the same precision as the first series. They bear out his assertions to the full, and with the exception of a few slight changes of technique, and a modification of the staining methods employed, have led him to no change whatever in regard to his views as first expressed more than two years ago.

These two papers taken together form a monument of scientific accuracy and care, and, so far as subsequent investigations go, will carry conviction to the mind of any impartial judge. Confirmatory evidence, as regards the occurrence of the organism in question in tuberculous lesions, has been offered upon all sides, and in enormous mass. The real evidence, however, the repetition of the culture and inoculation experiments, is sadly deficient. This is, perhaps, not to be wondered at, because the apparatus necessary is so extensive, the training so severe, and the aptitude for the work so rare. In addition to all this, the time necessary for the experiments is so great, that the chances are that they never will be repeated to their full extent, although it is only by such thorough and exhaustive investigation that progress in this branch of scientific medicine can be expected.

Some few observers have pretended to upset the conclusions of Koch upon the basis of extremely unsatisfactory and incomplete observations. Spina of Vienna is, or was, a prominent champion of this class. His book was announced with a flourish as being intended to overturn, and as actually accomplishing the destruction of, all Koch's theories. Upon its publication, it was found to be nothing but a criticism of methods that Koch himself acknowledged to be faulty, and a few observations upon the occurrence of the bacillus, but with an entire absence of any culture, or properly conducted inoculation, experiments whatever; in all respects being so far below the work it was meant to criticise, that it was with pain and mortification that we heard it mentioned on the same plane, in the annual address to the Massachusetts medical society of this year. This, however, seems to be the limit of any noteworthy objections in Europe: in this country it is different, a number of gentlemen having considered themselves authorized to speak in opposition to Koch's views upon the ground of personal observations. For the most part, however, their pretensions are too weak to receive serious notice: as, for example, Schmidt's cry of 'fat crystals;' Gregg's, of 'fibrine filaments;' Cutter's, of 'Mycoderma aceti;' or Formad's, of 'narrow lymph-spaces.' It is, perhaps, hardly fair to speak of Formad's deplorable failure to maintain his opposition to Koch by any reasonable arguments at the last annual session of the American medical association. Through imperfect counsel, the gentleman was induced to come before the meeting, and after announcing far and wide his intention to give results that would destroy the last vestige of strength to Koch's assertion in regard to the specific nature of the bacillus of tuberculosis, instead of doing this, proceeded to read a reprint of an article published by him last fall, announcing that his results would be published in the near future. This, in the present condition of all questions relating to micro-organisms in this country, seems to be almost inexcusable. These results have been promised for months, and at the time of writing have not yet appeared. It seems as if it were the bounden duty of all those honestly interested in the advancement of scientific knowledge to talk and publish less, and to work more. What is needed is the publication of the results of work carefully and conscientiously performed, together with the exact details of every step in every process by which those results were reached. In addition to this, we have a right to demand that all work of this kind shall be done by trained observers, in the presence of others equally well qualified for the observation, — not with and by half-trained students, — and that the very best appliances of modern research shall be employed in each and every observation made. In this way, and in this way only, can reliance be placed upon observations recorded in work on micro-organisms; and it is the absence of work of this kind which gives so very little force to the opponents of the specific nature of the bacillus of tuberculosis. At the same time, it is the presence of this very accuracy of the detailed account of every step in the process by which the results were reached, and of the completeness of the experiments and control experiments, that gives the convincing power to Koch's work. Nothing that can be for an instant compared with it for simplicity and directness of statement, or completeness of detail, has yet been brought forward by his opponents. Until that is done, and it does not look probable at the present writing, his work must be accepted as conclusive; and measures should be taken to control to some extent the wide-spread destruction of this disease, as it is most certainly within our power to do.

Koch's own work upon the subject of tuberculosis has been suspended for a year, owing to his absence in the east with the German cholera commission, with which he has lately returned. Whether he himself will take it up again is to be doubted; for his facilities for work are unbounded, and his natural impulse will, of course, be to open up untrodden paths of research.

THE GREENWICH OBSERVATORY.

THE board of visitors of this institution held its annual session on Saturday, June 14, and heard the report of the astronomer royal on the work of the observatory during the twelve-month ended May 20. Of this, Mr. Christie says, "It has gone on steadily in the same lines as in former years, with such small extensions in certain directions as could be made without infringing the long-established principle that

[1] *Mittheilungen aus dem rais. gesundheit*, bd. ii., 1884.

all observations are to be reduced and published without delay."

The fundamental instrument, the transit circle, has been kept well at work on the regular observations of the sun, the moon, the planets and fundamental stars, together with other stars, which, in the annual catalogue for 1883, number 1,550. The total number of transits observed was 5,213, and of circle-observations, 5,049, — a larger number of meridian observations than usual. But what is of more interest, the reductions of these observations are maintained in a state of forwardness unknown in national observatories generally. The computations on certain stages of the reductions of the meridian-work were reported to be well advanced on all observations up to the middle of May, 1884. It is worthy of note here, that the mean correction of the 'Nautical almanac' positions of the moon in right ascension turns out to be no larger than $-0^s.03$ for the year 1883. This interesting concordance of theory and observation is due to the adoption in the 'Nautical almanac' of Professor Newcomb's corrections to the 'Tables de la lune' of Hansen, which are the same as those employed in the construction of the 'American ephemeris.'

The observations with the altazimuth have been restricted to the period from the last quarter of the moon to the first quarter in each lunation; it being considered, that, from the first quarter to the last, the observations of the moon on the meridian will be obtained in sufficient abundance. The astronomer royal regards it as evidence of the great value of the altazimuth, that, during the former period, nineteen observations of the moon were secured with it at times when the moon's meridian-passage took place within three hours of the sun, and when observation with the transit circle was thus impracticable.

With the equatorially mounted refracting telescopes, only the usual observations were conducted; but, with the spectroscope, results of much importance and interest were reached. "For the determination of motions of stars in the line of sight, four hundred and twelve measures have been made of the displacement of the *F* line in the spectra of forty-eight stars, ninety-one measures of the *b* lines in nineteen stars, and two measures of the *D* lines in one star, besides measures of the displacements of the *b* and *F* lines in the spectra of the east and west limbs of Jupiter, and in the spectra of Venus and Mars. . . . Some preliminary measures have also been made of the *F* line in the spectrum of the Orion nebula. The progressive change in the motion of Sirius from recession to approach, alluded to in the last two reports, is fully confirmed by numerous observations since last autumn, and a change of the same character is indicated in the case of Procyon."

With regard to solar photography, undertaken with the view to determine the amount of spotted area, it is interesting to note that the heliograph, which up to the present time has given pictures of four inches diameter only, has been modified so as to take eight-inch pictures, as was suggested two years ago by the solar-physics committee. The photographs taken in India under the auspices of the same committee are now sent to Greenwich for reduction, thus resulting in a considerable increase in the number of days for which photographs are available. In 1883, for example, photographs on 215 days at Greenwich are supplemented by those on 125 days of India, giving a total of 340. In 1882, to 201 days at Greenwich were added 142 India, thus leaving only 22 days without photographs in the entire year. In the photographic branch of the observatory-work there has been much pressure "during the long-continued maximum of sun-spots, the work of measuring the photographs having been somewhat further increased by the adoption of large-scale photographs of the sun."

The acquisition of the Lassell equatorial, and the uses to which the astronomer royal proposed putting it, were mentioned in the report of the previous year. A new dome for this telescope, thirty feet in diameter, and covered with *papier-maché* on a framework of iron, was completed by the Messrs. T. Cooke & Sons of York in March last; and the building is now about complete in all its details. The instrument itself has been generally cleaned and repaired. The mirror is in very good condition as regards polish, and the definition on stars is satisfactory.

The magnetic and meteorological observations have been continued with the same regularity as in previous years. The mean temperature of 1883 was 49°.3, being 0°.4 lower than the average. The highest air-temperature was 85°.1, on Aug. 21; and the lowest, 20°.6, on March 24. The mean daily motion of the air during the year was 291 miles, which is 12 miles more than the average. The number of hours of bright sunshine during 1883 was 1,241, being about 30 hours above the average of the six preceding years. Mr. Christie informs us that no definite connection was noticed between magnetic or electric disturbances and the phenomena of the remarkable sunsets of the past winter.

THE UNITED-STATES GEOLOGICAL SURVEY.

Annual reports of the United-States geological survey to the secretary of the interior, ii., iii. J. W. POWELL, director. Washington, *Government*, 1882–83. 55+588 p., 32 fig., 62 pl.; 18+564 p., 56 fig., 35+32 pl. 8°.

IT has often been remarked that the problems of geology are expressed in far simpler terms in America than in Europe, the birthplace of the science. It is hard to say whether it would have been better for geology if it had been born in a less adverse environment. Perhaps it might have developed more rapidly, but probably not so healthily. Perhaps the very difficulties of the problems of geology in Europe — the conflicts of the schools through which the young science passed — have tended to invig-

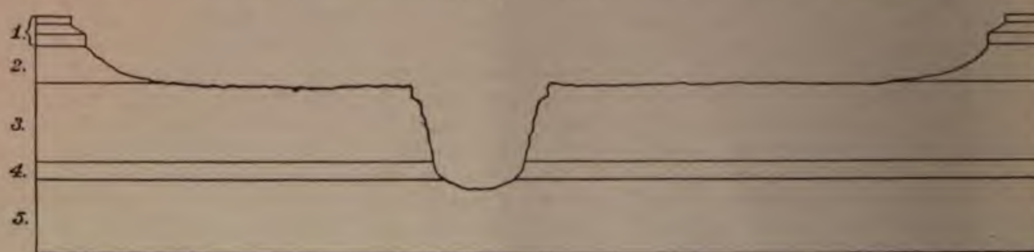
orate its life. However this may be, there can be no doubt, that, this stage of pupilage passed, it was well that a new and larger field was opened here on this continent, where its activity might be more productive, and its growth more steady. On the North-American continent, and especially in the United States, it would seem that each separate geological problem is stated in the clearest way. In stratigraphy, where shall we find a series so continuous and complete as in the region of the Wahsatch Mountains? In mountain structure, where are the extreme types so perfectly expressed as in the Appalachian on the one hand, and the basin ranges on the other? In land-sculpture, where are there examples so simple and grand as in the plateau region? Of the obscure phenomena of the glacial epoch, where may we hope to find an explanation, if not in eastern United States? In the still more obscure problems of chemical geology, such as the geneses of ore-deposits, — problems which have hitherto baffled the utmost efforts of science, — what field so promising as the American Cordilleras, where the process is still going on under our eyes? Finally, in paleontology, where are there fields richer than the paleozoic basin of the east, and the wonderful cretaceous and tertiary deposits of the west?

These reflections have been suggested by reading the two bulky volumes before us. There can be no doubt that the establishment of the U. S. geological survey is an epoch not only in the geology of this country, but in the science of geology itself. Excellent work has been done before by individual effort, by state surveys, and by surveys undertaken by the war and interior departments; but never before has the work been organized in a manner befitting so noble a field. The volumes before us are a proof of the excellence of the work being done: they consist of full abstracts of a series of monographs, most of which are yet unpublished. A simple enumeration of these is sufficient to show their great importance. They are Dutton's 'Physical history of the Grand Cañon district,' Gilbert's 'History of Lake Bonneville,' Russell's 'History of Lake Lahontan,' Hague's 'Geology of Eureka district,' Emmons's 'Geology of Leadville district,' Becker's 'Geology of Comstock lode,' Irving's 'Copper-bearing rocks of Lake Superior,' and Chamberlin's 'Terminal moraine of the second glacial epoch.' It is evident that only the most rapid review of these memoirs is possible here.

The geology of the plateau region, through the labors of Powell and Dutton, is so well known that only a brief recapitulation of its wonderful history is necessary. This region, now the highest in general elevation of the continent, was a sea-bottom, continuously or nearly so, from early carboniferous to the end of the cretaceous, and received, during this time, conformable sediments twelve thousand to fifteen thousand feet thick: this indicates, of course, a subsidence to the same extent. At the end of the cretaceous it began to rise, passing successively through brackish-water, fresh-water, land, and high-plateau conditions to the present time, the extreme elevation being not less than eighteen thousand to twenty thousand feet. Accompanying this elevation, and as its effect, there has been a general erosion by which from six thousand to eleven thousand feet thickness of strata have been removed over the whole area, leaving the plateau still from seven thousand to eight thousand feet high; and lastly, into this plateau, a cañon-cutting from three thousand to six thousand feet deep. The general erosion has given rise to a series of cliffs from a thousand to two thousand feet high, and extending for hundreds of miles; while the elevation, especially in its later stages, has broken the earth-crust into parallel oblong blocks from twenty to thirty miles wide and a hundred or more miles long, which, by settling unequally, have produced vertical displacements of a thousand to six thousand feet. These displacements, having occurred in comparatively recent times, have not yet been obliterated by erosion, and therefore still exist as cliffs. Thus, besides the east and west erosion-cliffs, there are also north and south displacement-cliffs: these latter pass by insensible gradations into monoclinal bends of the strata. As soon as the region became land, of course a river-system was established. As the region rose, the rivers cut down *pari passu*, and thus maintained their positions. The Grand Cañon itself, into which the tributaries drain, is in the axis of the elevation. Thus it has come to pass that the rivers run against the inclination of the strata, cutting deeper as the strata rise, southward. This remarkable persistence of river-beds, in spite of great orographic changes, was first pointed out by Powell.

The time when these different events occurred has been accurately determined by Dutton. In eocene times, nearly the whole plateau region was covered by the waters of a vast lake, in which many thousand feet of strata were deposited, — the same which yielded such treasures of mammalian remains to Marsh and

Cope. At the end of the eocene, this lake was drained by elevation, the present river-system was established, and the general erosion commenced. It is probable, that, during the miocene, the climate was moist, the rain excessive, and the general erosion very great. Most of the general erosion was done during this time. During the pliocene the elevation was greatly increased, the climate became dry, and, while a moderate general erosion continued, the stream-cutting became excessive. The upper, outer, and greater part of the Grand Cañon was made at this time (see the accompanying figure). Toward the end of the pliocene, things settled for a while: the streams reached a base-level, and cut no deeper for a long time. At the beginning of the quaternary, a somewhat rapid rising again began, and has continued to the present time. This last rising inaugurated the cutting of the inner cañon. The comparatively rapid rising of the pliocene and quaternary times produced the north and south faults, and, in connection with these, igneous outbursts on a grand scale.



Although the author does not, *we* would correlate this last elevation and its outbursts with the elevation and lava-flows which took place in California at the beginning of the quaternary, and the inner cañon of the Colorado with the deep cañons of the present river-systems of that state. In middle California the pliocene rivers were displaced by the lava-flows, and therefore had to cut new beds. These were cut much deeper than the old, because the country was greatly elevated at that time. But in southern California the country was elevated, but the rivers were not displaced: therefore, like the Colorado, they cut in the same place, but deeper; and remnants of the old beds are now found on the flanks of the present cañons.

Capt. Dutton has sometimes been criticised for a style unbecoming a scientific treatise. We do not agree with these critics. Nothing short of vivid word-painting can give any adequate idea of the peculiar scenery; and certainly in this Capt. Dutton excels. We would especially draw attention to his really magnificent description of the towers of Vermilion Cliffs (p. 86), of the temples and towers of Virgen River (p. 88), and his ride on Kaibab plateau to Grand Cañon (p. 136).

It is needless to say that the memoir is illustrated in a manner worthy of the subject.

It is already well known, through the previous labors of Gilbert and King, that in quaternary times the basin region was largely occupied by two great lakes, separated by the East Humboldt Range. The one occupying Utah basin, of which Great Salt Lake, Utah, Bear, and Sevier Lakes are the residues, was named by Gilbert, Lake Bonneville; while that occupying Nevada basin, and of which Pyramid, Winnemucca, Carson, Humboldt, and Walker Lakes are the residues, was named by Mr. King, Lake Lahontan. The complete study of these lakes has been undertaken by Mr. Gilbert and Mr. Russell. The great importance of this investigation lies in the fact that lakes without outlets are the clearest indicators of changing climate. We can only touch lightly the most important results, referring the reader to the memoir for the proofs.

According to King, in early pliocene a great lake, which he calls Lake Shoshone, covered nearly the whole basin region. This lake seems to have dried away almost completely by the end of the pliocene. At this point Gilbert takes up the history of the region. At the end of the pliocene, Utah basin had a dry climate and a small residuary lake, as at present. During the quaternary, the lake rose until it reached a level nine hundred feet above the present, but did not find an outlet. Then it dried away gradually and probably completely, and its residual salt was buried beneath fine clay, or 'playa deposits' of Mr. Russell. This was followed by a second rising, which reached still higher, and the lake found an outlet into the Snake River. The lake was therefore fresh. The outlet stream cut its way down three hundred feet or more, until, finding a hard limestone, the

LAHONTAN LAKE-BEDS IN HUMBOLDT VALLEY.

lake stood at the six hundred foot level a long time, making a very distinct terrace (Provo terrace). Then by change of climate it lost its outlet, and dried away to its present condition. Mr. Gilbert correlates these changes with the first glacial, the inter-glacial, the second glacial, and the post-glacial periods. Other very important facts brought out by Mr. Gilbert are those connected with recent orographic movements. The floor of Utah basin has recently moved, and is probably still moving. The movement is unequal. The floor is *warping*. The great fault on the west side of the Wahsatch has recently slipped, and will probably again slip. The Wahsatch Range has grown very recently, and is probably still growing. Such slips produce earthquakes. The great Inyo earthquake of 1872 was produced by a slipping of the great fault on the east side of the Sierra, as was first pointed out by LeConte.[1]

Mr. Russell's studies of Lake Lahontan entirely confirm the conclusions of Mr. Gilbert as to climatic changes. This lake also increased from mere residues to a level of five hundred feet above Pyramid Lake. Its shells show that it was at this time fresh; then it dried away completely, burying its salts, if any, beneath playa deposits. Then it rose again to the five hundred and thirty foot level (it was then also fresh); it again dried away to the present residues. Its terraces are traceable all around: it never found an outlet.

Mr. Russell continues the observations, commenced by King, on the remarkable deposits of this ancient lake. He divides these deposits into three kinds, which were made at different stages of the lake. In its first great rise, it deposited a hard, smooth, incrusting lime carbonate (lithoid deposit). At the one hundred foot level and downwards, it deposited what Mr. King calls thinolite, and which he regards as a pseudomorph after gaylussite. In the last and greatest rise, it deposited the dendritic tufa. Mr. Russell calls attention to the fact, that, if thinolite be a pseudomorph after gaylussite, it is difficult to understand what became of the enormous quantity of soda; for the lake never found an outlet. This problem is yet unsolved.

It is seen, then, that Lake Lahontan, like Lake Bonneville, shows two wet periods separated by a dry period, and probably two glacial periods separated by an interglacial period. Evidences of recent orographic movements are noted here also. Nearly all the basin ranges are formed by the tilting of long north and south crust-blocks, each block being dropped on one side, and lifted on the other. The faults thus produced have been slipped very recently, and are probably still slipping. The mountains are still growing.

[1] *Amer. journ. sc.*, vol. xvi. p. 101, 1878.

The three memoirs — of Emmons on the geology of Leadville, of Becker on the Comstock lode, and of Irving on the copper-bearing rocks of Lake Superior — all throw light on the genesis of ore-deposits.

In Mr. Emmons's admirable memoir we have a clear scientific account (the first ever given) of the wonderful argentiferous lead-deposits of Leadville. In this region the mountain system separating the plains from the plateau region consists of three ranges; viz., the Colorado, the Park, and the Sawatch. The first two are separated by the Parks; the last two, by the valley of the Arkansas River. The Park Range, in the vicinity of Leadville, is called the Mosquito Range. On the western slope of the Mosquito Range, or eastern side of Arkansas valley, is situated Leadville. The Mosquito Range consists of crumpled and faulted strata, from the Cambrian to carboniferous inclusive. The ore-deposits are in the carboniferous. Between the carboniferous strata are thick intercalary beds of porphyry, which have been forced between the separated strata without appearing on the surface. This irruption took place during the cretaceous. The whole series, both sedimentary and intercalary-igneous, was then folded and faulted. The mode of occurrence of the ore shows conclusively that it was deposited from solution in percolating water. The ore occurs in a gangue of oxides of iron and manganese, mixed with clay, in cavities and channels in the limestone. The limestone was dissolved and the ore substituted by the same water, the clay being the residuum of the dissolved limestone. The ore was originally disseminated in the porphyry, and thence leached out, and carried downward into the limestone. The original form was sulphides; but in many cases this has been subsequently changed into carbonates, chlorides, etc. It is seen, then, that these are not true fissure-veins, but deposits in irregular water-channels somewhat like the lead ores of Illinois, and like these latter, also, they occur in carboniferous limestone.

These important conclusions of Mr. Emmons in regard to the genesis of ore-deposits are substantially confirmed by Mr. Becker's study of the Comstock lode. This grandest of all lodes is, however, a true fissure-vein. We note only the most important conclusions of this careful memoir.

The vein is at contact of a diabase country on the one side, with a diorite on the other. Mr. Becker finds evidences of repeated slipping. Below, it probably cuts into the diorite. The ore was derived from the eastern diabase country, in the augite of which, analysis still finds the metals in small quantities. The disseminated metals were leached out and carried westward into the fissure, and there accumulated. The solvent water was hot, and contained alkaline carbonates and alkaline sulphides; in other words, was solfataric. The rocks were left in a widely decomposed condition. These conclusions are confirmed by the observations of others, as well as of Mr. Becker himself, on the phenomena of deposit of silica and metallic sulphides from solfataric waters, now going on at Sulphur Bank and Steamboat Springs. It is not unlikely that the process is still going on also in Comstock lode.

On several points Mr. Becker differs from previous observers. Richthofen, in his celebrated memoir on A natural system of igneous rocks, gives a prominent place as a rock species to propylite. Mr. Becker thinks, and probably rightly, that propylite is only an altered andesite, and therefore that the species is untenable. Rosenbusch, however, had already shown that propylite must be regarded as a modification of andesite, and Mr. Becker ought to have stated this fact.

Again Mr. Becker differs (and we think again rightly) from Church as to the source of the heat of Comstock lode. Church ascribed it to kaolinization. Mr. Becker shows the insufficiency of this cause, and suggests as a more probable cause solfataric action, the feeble remnant of previous volcanism.

The memoir of Mr. Irving on the copper-bearing rocks of Lake Superior deals with some of the most vexed questions in geology. When such men as Hunt, Whitney, Selwyn, Wadsworth, and Irving differ as to the age and stratigraphic relations of the copper-bearing series, those who have not personally examined the ground have no right to an opinion. Mr. Irving's view is, that this series partly fills the great gap between the Huronian and the Cambrian. It consists of sandstones and conglomerates, with interbedded sheets of igneous rocks, mostly basic; the whole being of enormous thickness.

As to the mode of occurrence and origin of the ore, there is a resemblance to, yet striking difference from, that of Leadville. As in Leadville, so here, we have alternating sheets of strata and lava; also, in both, the ore seems to have been leached from the igneous, and gathered in fissures, cavities, water-channels of any kind in the intervening strata, by means of down-percolating water; also, in both, the deposit seems to have been made by substitution; although the explanation of the substitution is more difficult in this case. But, on the other hand, the age of the strata is pre-Cambrian instead of carboniferous; the strata are conglomerates and sandstones instead of limestones; and the intercalary beds are contemporaneous instead of subsequent, i.e., poured out on the surface, and covered with sediments, instead of forced between the strata. As to the obscure question of the reactions by which ore was deposited, the author seems to adopt Pumpelly's view, that the copper was carried in solution as sulphate, and was reduced by the iron of the basic rocks, which oxidized itself at the expense of the copper sulphate.

The memoir of Hague on the Eureka district does not touch the mines of this district: that is left for a future memoir. It is confined wholly to descriptive geology. As such, although not entertaining popular reading, it is a model of painstaking, conscientious work. It is on such work, and such only, that a true geological science must be built. Only one point we have time to notice. Mr. Hague declares that there is no trachyte at all among the western eruptive, what has gone under that name being andesite. This decision is founded on the fact that plagioclase is the dominant felspar in all of them. The fact admitted, the decision seems well founded. But surely some consensus of view as to the basis of classification of eruptive is devoutly to be wished for. Shall it be the look and habit, or mode of occurrence, or mineral constitution, or age, or all these together? When shall order come out of this chaos?

It is a pity that Mr. Chamberlin's paper on the second glacial moraine comes last among the geological articles; for we are pressed for room, and the subject is to us a specially inviting one. The author commences his work by trying to remove the confusion which exists on the subject of drift-deposits. He makes three kinds of till: viz., 1, subglacial or true till; 2, englacial or superglacial till (a looser top material); 3, subaqueous till, often confounded with the first, but deposited by floating ice. He also distinguishes between osars and kames. After many other distinctions which deserve studious attention, he describes the peculiar structure and appearance of terminal moraines, and then applies these principles to the identification and tracing of the second glacial, or

GENERAL MAP OF THE TERMINAL MORAINE OF THE SECOND GLACIAL EPOCH.

so-called 'kettle' moraine. As is well known, chiefly through the work of the author, together with Upham and others, this moraine consists of a series of loops about the Great Lakes, and continuing thence eastward and westward. Commencing with the Green-Bay loop as most typical, the author describes every loop separately and minutely, taking them in succession going eastward, and then returning and going westward. All we can do here is to trace briefly the course of this moraine as shown in the map, plate xxviii.

Commencing eastward, this moraine passes through Cape Cod and through Long Island, to New York. This part is often described as the first glacial or *limit moraine*. If so, the two are here coincident. But possibly the true limit is farther out to sea; or, more probably, the ice-sheet at its farthest limit ran out here into the sea, and formed no moraine at all, its *débris* being carried away by icebergs. From New York the two moraines separate, the limit moraine passing through New Jersey and Pennsylvania, where it has been traced by Cook and Lewis; while the second glacial moraine turns northward into middle New York, passes in a curve around the Finger Lakes, and then southward to join the limit moraine in eastern Ohio. After running together a little way, they again part company, the limit moraine passing along an irregular line a little north of the Ohio River, then crossing the Mississippi and following the south and west side of the Missouri River into Montana and British America; while the second moraine turns northward, sweeps about the Great Lakes in a succession of loops, and then, making two more grand loops, — one in Iowa and one in Dakota, — it finally passes along the Coteau of the Missouri, and onward into British America.

The importance of the work of Mr. Chamberlin and Mr. Upham, in connection with that of Messrs. Cook, Lewis, and Wright, on the first glacial or limit moraine, in their bearing on the question of the existence of a veritable ice-sheet, cannot be overestimated.

In the paper on barometric measurements by Mr. Gilbert, a new method of measuring heights is brought forward. The essentials of this method are as follows: —

For the purposes of observation there are two base stations, one high and one low, the difference in altitude between them being as great as possible, compatible with close verticality. At these two stations, only the barometer and its attached thermometer are observed, no other instrument being considered necessary. The actual difference in altitude between these base stations is determined by spirit-level; and this constitutes the altitude, — a vertical base-line, by which all other altitudes are gauged.

The field-notes consist of barometric readings applying to the upper base station, the lower base station, and the new station, respectively.

The method of computation consists in first correcting the instrumental readings for index-error and temperature. These readings are then collected in groups of three, each observation at a new station being associated with the coincident observations at the base stations. The altitude of the upper base station is then computed as usual, without applying the corrections for moisture, temperature, or gravity; and the height of the new station above the lower base station is calculated in the same way, thus assuming that the air is dry, and has a uniform temperature of 32° F.; and, these two results being considered approximate, the following proportion is made: —

Approximate height of base-line : True height of base-line : :
Approximate height of new station : True height of new station.

There is little of importance in this publication that has not appeared previously in some form or other.

Of course, the method would, in the first place, be limited in its application to a very small horizontal area; for only in such an area could the conditions of density be similar enough to allow of its use: and the first thought that would strike one would be the comparatively rare occurrence of the conditions of verticality proposed, though the method certainly has the mark and merit of ingenuity.

Most of such devices are designed to do away with the influence of the 'hour of the day,' as it is called, or the varying effect of the different conditions of temperature and moisture. Any real control over these elements in the problem must come from the careful noting of all the circumstances under which the data are collected; and the question can only be decided, if it ever is, by observations continued for a long time.

The only great effort to secure the data for this 'horary' correction was made by Plantamour, in his discussion of the forty-year series of observations carried on between Geneva and the St. Bernard hospice:[1] but this series only covers one of the many conditions under which such measurements may be made, for decided differences would be introduced by unequal insolation along mountain chains, near

[1] Mém. Soc. phys. Genève.

plateaus (whether high or low), on the coast, or in different seasons; and it would seem from these records that the only means of obliterating the effect of these temporary disturbances is in having a large number of observations made, and taking their average.

This would also seem to throw some doubt upon the value of Williamson's method of obtaining this correction from the curve of the day: for days differ so much that a large arbitrary or constructive element would be introduced, thereby damaging the results as far as scientific accuracy is concerned; for we can easily see that the difference between a clear, bright day, and a day in which the sky might be wholly or partly covered, would be great, and therefore much would be left to the judgment of the observer with regard to applying the whole or only a part of any correction which might be obtained for use in such cases:[1] for, at best, we only get a sort of skeleton average from the mathematical formulae; and it is quite certain that the formula of Laplace gives too high results for general use, since it is only adapted for the summer months.

The second objection to this method, therefore, would seem to be found in the comparatively arbitrary use of the data obtained.

If we could only obtain a partial solution of this problem by securing a portion of the proper correction, it would be a great gain.

The temperature correction would not, perhaps, be so difficult to obtain; but, when we once introduce the element of moisture, we perceive that the uncertainty of controlling the conditions increases, except by having full averages of all the elements involved, as their variability is so great.

One has only to look into the work of Plantamour to become convinced of this; and the results obtained from these records, as worked out by Dr. Guyot, show it conclusively.

It has therefore been Dr. Guyot's principle to simplify the methods, both of observation and of computation, as much as possible, so as to facilitate the making of a large number of observations, and from their averages obtaining better results. By this means the original records are touched as little as possible; and the results are sufficiently accurate for the purposes of the geographer.

The trouble is, that these difficulties arise from the nature of the problem; and it is very doubtful whether they will ever be completely mastered.

There is another objection to the proposed method, which would seem vital; and that is, that it materially increases the cost of such a survey, not only by the employment of an additional observer, but also by making the measurement of a number of vertical baselines by level a necessity in an extended survey; and any thing which does this, thereby bringing the expenses nearer to the amount necessary for a regular levelling-survey without proportionally increasing the accuracy of the results obtained (for the liability to errors of observation and computation is greater), is at least of questionable advantage.

[1] Bulletin No. 2, E. M. museum of geology and archaeology.

In his 'Non-marine fossil Mollusca,' Dr. C. A. White presents a valuable review of the North-American brackish, fresh-water, and land Mollusca, beginning with their first representatives in the Devonian, and tracing the history of many cases of persistence to modern forms. Every paleontologist has to contend with large gaps in material; and these are more extensive among the inland than among the marine Mollusca. Another difficulty lies in distinguishing between the brackish and fresh and salt water forms. These are often commingled, especially in the Laramie rocks, which bear evidences of frequent littoral changes in the estuaries and inland seas. Following a geological introduction, the author presents an elaborate historical catalogue of the genera of the Conchifera and Gasteropoda. There is a happy omission of any attempt at revision of species (an endless task), and little technical description; while more attention than usual is given to the interesting question of changes of habitat during successive periods, and relationships with other fossil and modern forms. A curious fact, which has so many parallels among the other Mollusca, is the early appearance and development of the pulmonate gasteropods, which are found as low as any of the Conchifera. With the necessary presumption of the derivation of the non-marine from the marine types, the author infers that this has taken place not only in paleozoic, but in more recent geological times. The marine types, having suffered the fewest changes of environment, have been the most persistent; then rank the land and brackish-water types; but, in view of the continual changes in the fresh-water areas, the persistence, even to the present day, of several fresh-water forms, is most remarkable. According to the author, the latter forms abounded in the great tertiary lakes: they survived the contraction of the lakes into the great river-systems, and they owe their wide dispersal to the confluence of these river-systems, as in the case of the Ohio and Mississippi, which originally poured into the Gulf. It appears that

areas of extinction have been areas where the old river-courses have changed or dried up; and these, according to Powell and Dutton, are comparatively few. An interesting line of research suggests itself here, which lack of material may prevent at present, upon the divergence of structural characters after the separation of the eastern and western fauna by the Rocky-Mountain system.

Professor Marsh's paper upon birds with teeth contains little that did not appear in his monograph, 'Odontornithes:' it is, in fact, an abstract of that volume, with the omission of many details of structure. There have been added, however, several characters to Archaeopteryx, which the author himself discovered upon the European specimens. It is an astonishing fact, worth mentioning here, that in many foreign museums it is still considered more important to preserve these specimens intact than to publish the rich truths they might reveal under a careful use of the hammer and chisel.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

Rocks from Oregon. — During the field-season of 1883, Mr. Frank Wood, a stone-cutter in Albany, Or., contributed to the Cascade-Range collection of rocks several specimens of stone used extensively in that part of the country for building and ornamental purposes. They were examined by Mr. J. S. Diller, and proved to be of unusual interest, not only on account of their economic value, but also for their bearing upon the geological history of the Cascade Range.

Among them was an eruptive rock, which is quarried twenty miles east of Albany, on the western slope of the Cascade Range, and which presents an ancient aspect. The composition of this rock is that of a diabase with an admixture of rhombic pyroxene; but in its general facies and structure, as well as in the character of its alteration products, it is closely related to the gabbros. Rocks of the same character, high up in the mountains, are abundant a short distance south-west of Mount Hood. While it has long been known that the Cascade Range is built up chiefly of recent lavas, it is becoming more and more evident that eruptions of gabbroic and granitic rocks must be admitted as important elements in its construction.

On the Willamette River, eight miles from Albany, a sandstone is quarried which belongs to the tertiaries of the Willamette valley, and, with the exception of the cementing-material, is composed wholly of volcanic matter. When first taken from the quarry, it is said to be soft, and easily carved into any desired shape. Upon exposure, it becomes hard and more durable. This change in its physical character, so far as can be judged from the hand specimen in the collection, appears to be connected with a peculiar alteration in its cement. The unaltered sandstone, when held in such a position as to reflect the light from its surface, is seen to have a peculiar shimmer, which, upon closer examination, is found to come from the brilliant cleavage-surfaces of the well-crystallized calcite which forms the cement. The rock splits quite readily in three directions. Following these lines of easiest cleavage, a small rhombohedron was split out of the sandstone, which showed the peculiar shimmer on all sides. With an improvised goniometer, the angles between the reflecting surfaces were measured, and found to be the regular cleavage-angles of calcite. In the thin section it could readily be seen that the calcite cement had the same optical orientation throughout. There can be no doubt that all the calcitic cement within the hand specimen belonged essentially to the same crystal. Professor Irving has shown that siliceous cement in sandstone is very frequently arranged with reference to the crystallographic axes of the quartz-grains which it envelops. It is much less common, however, to find the cement arranged as in this Albany sandstone. That carbonate of lime can arrange itself in one crystal, when mixed with from fifty to sixty per cent of sand, is clearly shown by the well-known crystals from Fontainebleau and Nemours, in France. Under atmospheric influences, the calcitic cement appears to be replaced by one which is in large part siliceous. The boundaries of the grains of sand become less distinct, and the cement assumes a spherulitic structure. To be able to assert positively that this peculiar structure in the cement of a sedimentary rock is due to weathering, our observations with the microscope need to be supplemented by an examination of the rock *in situ* at the quarry. The rock, therefore, becomes more durable, being insoluble, and is much less liable to injury from great and sudden changes of temperature.

Krakatoa dust. — A report by Mr. Diller, on the Krakatoa dust submitted to him for examination, has been completed. Reusch determined the rhombic pyroxene in the Krakatoa dust to be bronzite, while Daubree, Renard, and others have asserted that it is hypersthene. Although Mr. Diller obtained the dust from four different localities, enough was not received to furnish sufficient rhombic pyroxene for chemical analysis to settle the question; and without a Nörrenbergs apparatus, or a microscope with a larger field than the one used by Mr. Diller for the observation of optic axial figures, so that the char-

acter of the double refraction of biaxial minerals can be determined, it is impossible to distinguish with certainty between bronzite and hypersthene.

PUBLIC AND PRIVATE INSTITUTIONS.

Johns Hopkins university.

Physical laboratory. — During the past year, original investigations have been carried on, on the photography of the spectrum by the concave grating, the variation of the magnetic permeability with change of temperature, the distribution of heat in the solar spectrum, the determination of the B. A. unit of electrical resistance in absolute measure, and the determination of the specific resistance of mercury; and experiments have been carried on, under the direction of Professor Rowland, with an appropriation from the government of the United States, with the view to aid in establishing an international unit of resistance.

Chemical laboratory. — The following investigations have been completed during the year: a contribution to the history of active oxygen, the action of heat on ethylene, the chemical conduct of the sulphinide obtained by oxidizing α naphthaline-sulphamide, the effect of light on fermentation, and the relative stability of halogen derivatives of carbon compounds.

Biological laboratory. — During the year, original investigations, the results of which either have been or soon will be published, have been made in the following subjects: the nature of the process of the coagulation of blood; the chemical composition of the blood of the terrapin; the influence of various salts and other substances on the contraction of the arterioles; the suction-pump action of the heart; the influence of sudden variations of arterial pressure on the rhythm of the heart; the action of carbolic acid on the heart, and its antagonism by atropine; the influence of convallarin and convallamarin on the heart; the anatomy of Nemertians; the development and metamorphosis of various insects; the development and histology of Salpa; and the histology of Amiurus.

Marine laboratory. — During the summer of 1883, the seaside zoölogical laboratory for the study of forms of marine life was open at Hampton, Va., from May 1 until Sept. 29. The advanced work included original investigations on the following subjects: the anatomy and development of barnacles, the anatomy and development of crabs, the histology of Eudendrium, the anatomy and development of Balanoglossus, the development of the oyster, the anatomy of Lingula, the protozoea stage of crabs, the development of annelids, the anatomy and development of Chrysaora, the origin of the eggs of hybrids and tunicates, the function of the semicircular canals of sharks, and the general zoölogy of the Hydromedusae.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Trenton natural-history society.

July 8. — Dr. C. C. Abbott remarked on the spadefoot hermit-toad, Scaphiopus solitarius, the least common of the batrachians. Their appearance after long intervals seems characteristic. The speaker observed them in 1874, and not again until April 10, 1884. By the 15th, the weather becoming cooler, they departed. On the afternoon of June 26, after a severe storm, they became abundant in the same pond. The eggs are deposited about submerged objects, hatching in six days; the tadpoles growing rapidly, and the young toads leaving the water in two or three weeks. Like true frogs, this terrestrial batrachian can probably thrive fairly well in water. The creature's vocal powers are terrific. The sound has been compared [illegible] that produced by a heavily loaded, creaking wagon, [illegible] over hard and uneven ground, and to the [illegible] [illegible]izing pain. Travellers on the highway [illegible] distant, listened in amazement; [illegible] is, thus compelled to considerably [illegible] he mules refused to approach [illegible] yells. With the sound, a [illegible] imal's size appears beneath [illegible] ually decreasing with the [illegible] ot entirely disappearing. [illegible] ches deep, dug by itself, [illegible] ept at the breeding-season. At the bottom of the pit it seizes such insects as enter, and probably seeks food by nocturnal wandering. The burrows, which it forms by throwing the earth to both sides by the assistance of the spur-like projection on each hind-foot, have a smooth, somewhat tortuous, tubular entrance, oval in outline, and sufficiently large to allow of egress: the toad sitting in a chamber so placed that it would seem impossible for it to leap out, as De Kay suggests, when food appears about the orifice at the surface. Indeed, tunnels made in confinement were always angular; and it would be impossible for the animal to see an insect at the opening. The toad, therefore, probably leaves the hole, and seeks food at night. —— Mr. William Macfarland detailed his experiments on the building-habits of the basket-worm, Thyridopteryx ephemeraeformis. If the full-grown larva is removed from the case, it will not rebuild. But this is not so with the young worm: an individual about two-thirds grown had rebuilt five times. The worm creeps under a leaf, enclosing itself by drawing the edges together with threads of silk. The leaf is then cut loose, the larva adding bits of sticks as the case is dragged about. —— Dr. A. C. Stokes presented a communication on the liver of the house-fly, with dissections. The organ consists of two sets of tubules, originating in sub-spherical bulbs, and uniting to form two tubes opening on opposite sides of the intestine behind the

stomach. These are formed of delicate membrane, lined by a layer of secreting-cells so arranged that a central channel is left for the transmission of the bile. The cells are polygonal from mutual pressure, nucleated and nucleolated, often projecting, and giving the tubes a beaded aspect. The bile is apparently composed of oil-globules and many fine dark granules. The entire organ is very tortuous, and closely applied to the alimentary canal.

Minnesota academy of natural sciences.

June 3. — Mr. C. L. Herrick described Spirochona gemmipara Ehr., — an infusorian found parasitic upon the gills, legs, and gill-covers of Gammarus lymnaeus, near the university grounds. The European Spirochona was the subject of an elaborate memoir by Hertwig, and was shown to be one of the most pleasing subjects for the study of the subdivision of the nucleus. Attention was drawn to the fact that the American species of Spirochona seems beyond a doubt identical with the European, while the Gammarus, upon which it lives, is of a different species from that forming its host in Europe. It was not found upon Hyallela or elsewhere. Spirochona Scheutenii Stein is the only other member of the genus, and may not be distinct. —— Mr. Herrick also mentioned the occurrence of another curious protozoan in Minnesota, this form being similar to Ophridium versatile of Ehrenberg. The animal bearing this name is allied to the Vorticellae, and is social; but the colonies adhere to the surface of crystal-clear masses of jelly, which may be as large as one's fist. The individuals are sessile upon the sphere, and are peculiar in the great length of the neck-like anterior part of the body when extended. The American specimen measured 0.16 of a millimetre when quite extended. The width of the peristome is .024 of a millimetre. The species was provisionally called Ophridium problematicum. A third infusorian was described as closely related with Paramoecium, but differing in several interesting particulars from it and its allies. In form, this animal is linear lanceolate (about 0.2 of a millimetre long), tapering posteriorly to an almost acuminate point. Anteriorly is a long vibratile proboscis, or flagellum, which exceeds, when extended, the whole length of the body. The mouth is situated at the base of this proboscis, and opens into a very short infundibulum. The whole surface of the body and proboscis is covered with minute cilia, which are inserted in rows, giving the body a punctate appearance. Longer cilia surround the mouth. The sarcode is transparent, and, aside from a few greenish food-balls, contained only a large number (over a dozen) of oval bodies of a similar character (endoplastules in an unobserved coiled endoplast?) The motions of the animal are very quick, and are occasioned chiefly by the whip-like motions of the proboscis, which is extremely vigorous in movement, and alters its form greatly. Aside from this rapid motion, it can propel itself slowly by means of the cilia covering the entire surface. It is the type of a new genus, and was called Phragelliorhynchus nasutus. —— Rev. L. J. Hange contributed a letter on the vegetable remains of the drift. As a missionary among the Scandinavians and Indians of the north-west for over a quarter of a century, his attention has been called frequently to these remains; and he has over seven hundred specimens of woods, leaves, etc., in his collection. In Minnesota, wood is found at from thirty-five to forty-five feet below the surface: going west into Dakota and Montana, the depth is greater. On the Missouri, above Bismarck, a stump twenty-three feet high and a foot in diameter was struck fifty-nine feet below the surface. Many pines have wood well preserved; others are completely silicified and chalcedonic. Upon many a high point of land in western Dakota one finds a pile of stones, and among them some fine specimens of the silicified wood peculiar to this region. These piles were evidently built by human hands; and the writer suggested that they were built by the Indians as altars or landmarks. —— Rev. Dr. H. C. Hovey related some interesting facts touching the habits of the ant-lion, a colony of which he keeps in his study.

NOTES AND NEWS.

Over one hundred members of the British association have notified the local committee at Philadelphia of their intention to be present at the meeting of the American association. About seven hundred of the British association are expected at the meeting in Montreal.

— *Nature* states that the arrangements for the meeting of the geological section of the British association are now well advanced.

The International geological congress meets at Berlin in September, and this will prevent many continental geologists from going to Montreal: Dr. Richthofen, however, will probably be present, and will communicate a paper on some comparisons between the geology of China and North America. It is hoped that others may also arrange to come.

Meeting in the typical Laurentian country, it is only to be expected that the archean rocks will receive much attention. Amongst the papers sent or promised are the following: Professor Bonney, on the lithological characters of the archean rocks in Canada and elsewhere; Mr. Frank Adams, on the occurrence of the Norwegian 'apatitbringer' in Canada, with a few notes on the microscopic characters of some Laurentian amphibolites; Dr. T. Sterry Hunt, on the eozoic rocks of North America.

On paleozoic geology and paleontology generally, the following are expected: L. W. Bailey, on the Acadian basin in American geology; E. W. Claypole, the oldest known vertebrates, — an account of some fossils recently discovered in the Silurian rocks of Pennsylvania; J. H. Panton of Winnipeg, geological gleanings from the outcrops of Silurian strata in the Red-River valley, Manitoba. Principal Dawson will give a comparison of the paleozoic floras of North America and Europe, whilst Mr. J. S. Gardner will

deal with the same subject as regards the cretaceo-tertiary floras. Other papers are: G. F. Matthews, on the geological age of the Acadian fauna, and on the primitive conocoryphean; E. Wethered, the structure of English and American coals.

After the azoic and paleozoic rocks of Canada, the drift-deposits are of great interest. The following papers bear on this subject: Mr. A. R. C. Selwyn, on a theory of ice-action in the formation of lake-basins and in the distribution of bowlders in northern latitudes; the Rev. E. Hill, on theories of glaciation; F. Drew, on the thickness of ice in the Himalayan valleys during the glacial period.

Amongst other papers of interest are: Professor Hull (who is not expected to be present), on the geology of Palestine, giving an account of his recent explorations; Prof. T. R. Jones, on the geology of South Africa; W. Whitaker, on the economic value of geological maps, with especial reference to water-supply, illustrated by the survey maps of the chalk area in England. Papers are also promised by Dr. Arch. Geikie, Dr. G. M. Dawson, Prof. V. Ball, Prof. W. Boyd Dawkins, Dr. C. Le Neve Foster, W. Carruthers, H. Bauerman, E. Gilpin of Halifax, N.S., and others.

Several reports will be submitted by committees, or by persons appointed for this purpose at the last meeting of the association (the name mentioned is that of the secretary to the committee, or the reporter): Prof. J. Milne, earthquakes in Japan; W. Cash, fossil plants of Halifax; G. R. Vine, British fossil Polyzoa; Dr. H. W. Crosskey, erratic blocks of England, Wales, and Ireland; Prof. T. R. Jones, fossil Phyllopoda of the paleozoic rocks; C. E. De Rance, underground waters; J. W. Davis, Raygill fissure, Yorkshire; C. E. De Rance and W. Topley, erosion of seacoasts of England and Wales; F. Drew and Prof. A. H. Green, the present state of knowledge respecting the interior of the earth; W. Whitaker, geological record; W. Topley, national geological surveys, and progress of the international geological map of Europe.

The local committee at Montreal is preparing a guide-book to the city and neighborhood, which will contain a geological map. A general geological guide to the dominion will be prepared by the geological survey of Canada.

— We regret to learn, that, at the close of the first year, Williams college relinquished the only American table held at the Naples zoölogical station. It was occupied in the first part of the year by Dr. E. B. Wilson, and, in the latter half, by Prof. S. F. Clarke of the college; who, however, was taken ill soon after reaching Naples, and is not yet fully recovered. Only one applicant for the table appeared for the second year.

— Raoul Pictet writes to the *Journal de Génève* of his first acquaintance with Wurtz, as follows: —

"It was in 1867. I reached Paris with a letter of introduction from Mr. A. de la Rive, I entered the court-yard of the medical school, where was pointed out to me a square room quite poorly lighted, and rather small for the twenty students who narrowly found place there. Mr. Wurtz, in laboratory costume, alert and active, was going from one to the other, and was talking with great animation. One of his favorite scholars was at this moment taking his examination for the fellowship, with what anxiety to know the result.

"I shall never forget the words which Mr. Wurtz with frank cordiality addressed to me: 'You come from one of the masters of science; my laboratory is open to you; there are but twenty places; ah, well! this year there will be twenty-one of us.' Then after having appointed me to a place, and introduced me to Mr. Wilm, his chief attendant, he added, 'By the way, you know, I receive Friday evenings; you will always be welcome; this invitation I never repeat.'

"And in this way the students who were fortunate enough to be near the teacher found in him at the same time a learned professor, a director of their studies, an inspirer of their discussions, a defender of new but logical ideas, and a friendly adviser, an interesting and cheerful converser, a host at enjoyable and easy receptions, happy to please and to be useful to those whom he considered his intellectual family. How can I reproduce here the impression left by the scientific discussions excited in the laboratory by the work of a scholar or by a new discovery! There was an enthusiasm, an impulse, a joy, which we all felt under the direct and spontaneous influence of an instructing friend, a respected master."

— The fifth international hygienic congress will be held at The Hague from the 21st to the 23d of August, under the presidence of the ministers J. Hemskerk and de Beaufort. The work of the congress will be divided into five sections, and lectures will be given from three to four o'clock every afternoon. The principal speakers will be L. Pasteur, on methods of infection; H. Paechiotti of Turin, on the hygiene of the future; Professor Finkelnburg of Bonn, on the influence of the microbe theory; Jules Rochard, on the value of public hygiene; Stephen Smith of New York, on the medical professions in the United States; E. J. Marey of Paris, on useful powers in the forward movement; W. H. Corfield of London, on science and sickness; E. Irélat of Paris, on hygiene in dwellings: J. Crocq of Brussels, on drinking-water. Other lectures will be given by Drs. Koch and Bockh of Berlin. Applications for participation in the congress should be addressed to Professor van Overbeck de Meijer of Utrecht.

— At a late session of the section of physical and experimental science of the Royal society, Mr. G. Johnstone Stoney, late astronomical assistant to the Earl of Rosse, described a form of instrument which had proved very successful in completing the optical adjustment of reflecting-telescopes. The new collimator which he invented as long ago as 1857 was made by Mr. Grubb last autumn, and is a short-focus telescope of two inches aperture and eleven inches long, which, when used, is to be inserted into the eyepiece-holder of the large reflector. A spark between

platinum points is produced in the focus of this instrument by a small Rhumkorff coil; and the light of the spark, emerging from the collimator, is reflected by the small mirror of the Newtonian, and thence to its large mirror. On pushing the collimator-eyepiece and platinum points a little inside the focus, the beam of light will, if every thing is in perfect adjustment, retrace its steps after reflection by the large mirror, and, re-entering the collimator, form an image coincident with the spark; and any want of adjustment is at once betrayed by the image in the field of view of the collimator not being coincident with the spark. Mr. Stoney represented this entire process of completing the adjustment as occupying less than half a minute, and as being so easy of application that he is in the habit of repeating it every time the telescope is turned upon a new object.

— In a lecture, May 23, at the Royal institution of Great Britain, on recent researches on the distances of the fixed stars, and on some future problems in sidereal astronomy, Dr. David Gill, her Majesty's astronomer at the Cape of Good Hope, summarized as follows the late investigations at that place on the parallax of stars in the southern hemisphere: —

Name of star.	Observer.	Parallax.	Years.
α Centauri	G. & E.	0.75″	4.36
Sirius	G. & E.	0.38	8.6
Lacaille 9352 . . .	G.	0.28	11.6
ε Indi	G. & E.	0.22	15
o_2 Eridani	G.	0.17	19
ε Eridani	E.	0.14	23
ζ Tucanae	E.	0.06	54
Canopus	E.	Insensible.	–
β Centauri	G.	Insensible.	–

The last column contains the star's distance in light-units, or number of years in which light from the star would reach the earth. The observers are Dr. Gill and Dr. Elkin, now of the Yale college observatory, New Haven.

— Oberlin college, in Ohio, has acquired the botanical collection of Dr. Beardslee of Painesville, containing not far from three thousand species. The main part of the collection consists of the phanerogams of northern Ohio; but it also has many plants from the United States generally, especially sedges, grasses, and willows, with over six hundred species of mosses.

— The New-York *Sun* for June 25 gives an instance of ingenuity on the part of some orioles in Central Park, which, finding the twig on which they were building their nest too weak for its support, fastened it by a long string to the branch above.

— Mr. Arthur R. Hunt read a paper to the Linnean society of London, on June 5, on the influence of wave-currents on the fauna inhabiting shallow seas. The author refers to various physical data, among others quoting Professor Stokes and Mr. T. Stevenson; the latter stating that a current of 0.6819 of a mile per hour will carry forwards fine gravel, and that of 1.3638 will roll along pebbles an inch in diameter. From this and other facts, Mr. Hunt argues that wave-currents do materially influence the marine fauna inhabiting shallow water, not only those of the tidal strand, but likewise those inhabiting the deeper sea-bottom. He adduces instances of animals living among or on rocks, and of those frequenting sand or other deposits, enumerating species of starfish, mollusks, shrimps, crabs, and fish. He says that even the flat fishes (Pleuronectidae) seem to have changed their original forms and habits for the purpose of being able to live in shallow waters agitated by waves. Referring more particularly to species of Cardium, he endeavors to show how, under the influence of wave-currents, the variation of species may be promoted, and even their local extinction brought about.

— Professor Sir William Thomson, of the University of Glasgow, and Prof. E. Frankland, have been elected honorary members of the Academy of sciences, Vienna.

— Professor Ayrton has been formally appointed professor of physics at the Central institution of the City and guilds' institute, London.

— Mr. Carl Pearson has been appointed professor of applied mathematics at the University college, London.

— Professor Edward Hull of the geological survey of Ireland, and his party, sent to Arabia Petraea under the auspices of the Palestine exploration fund, have made a complete traverse of the Wady el Arabah, and constructed a special geological map of this grand valley, as well as a general one of the whole region between the Red Sea and the mountains of Edom and Moab, — the latter on a small scale, thirty miles to the inch, to accompany the personal narrative which is to appear in November next; the former on a larger scale, for the scientific report, which will appear later. The scientific report will be chiefly geological, but will probably contain zoölogical and botanical chapters by Mr. H. C. Hart, and meteorological data by Mr. Lawrence, together with a beautiful hill-shaded map of the Wady el Arabah, constructed by Major Kitchener and his assistants.

— It is proposed to organize, under the auspices of the American social science association, during its next annual session at Saratoga, Sept. 8–12, an American historical association, consisting of professors, teachers, specialists, and others interested in the advancement of history in this country. Arrangements will be made for the presentation of a few original papers, in abstract, at the first meeting of the American historical association, which will be held in Putnam hall, Saratoga, Tuesday, Sept. 9, at four P.M.

— Before the section of physiology of the international medical congress of Copenhagen will be brought the following problems and communications: Professor Hammarsten of Upsala, the mucous substances, and their relation to the albuminoid substances; Prof. R. Norris of Birmingham, and Professor Hayem of Paris, the *rôle* of fugitive corpuscles in the formation of fibrine and coagulation, and the relation

between the hematoblasts of Hayem, the *piastrines* of Bizzozero, and the fugitive disks of the blood of Norris; Professor Dogiel of Kazan, the coagulation of fibrine; Dr. Wooldridge of Cambridge, the coagulation of blood; Professor Worm-Müller of Christiania, the proportion of the number of the red globules of blood to the quantity of haemoglobin and to that of the dry globules; Dr. Otto of Christiania, the latest researches on haemoglobin and methemoglobin; Dr. C. Bohr of Copenhagen, researches to determine the absorption in the dissociation of oxyhaemoglobin; Professor Charles of Cork, the gas found in the secretions, especially the bile; Professor Engelmann of Utrecht, Professor Ranvier of Paris, Professor Merkel of Königsberg, and Professor Retzius of Stockholm, demonstrations to show the structure and changes in form of the muscular fibres and of protoplasm in relation to their physiological function; Professor Heidenhain of Breslau, and Dr. Langley of Cambridge, the modifications of the glandular cells during their activity, and the relation between these modifications and the question of the trophic nerves; Dr. Gaskell of Cambridge, the inhibitory or restrictive actions of nervous force, and the restricting nerves in general; Professor Dogiel of Kazan, the causes of the movements of the heart and of their regulation, and of the condition of the hearts of animals which have died from the effects of various poisons; Professor Kronecker of Berlin, the centre of co-ordination of the movements of the auricles of the heart; Prof. H. Munk of Berlin, the functions of the cortex of the cerebral hemispheres; Professor Mosso of Turin, Professor Marey of Paris, and Dr. François-Franck of Paris, the mechanism of the circulation; Dr. François-Franck of Paris, the experimental pathology of the circulation of the blood by artificial lesions of the heart; Professor Burdon Sanderson of London, and Professor Mosso of Turin, the application of instantaneous photography to physiological researches; Professor Marey of Paris, the application of instantaneous photography to the study of voluntary movements; Professor Hensen of Kiel, and Dr. B. Baginsky of Berlin, the relation between the structure and the function of the labyrinth; Dr. Blix of Upsala, the specific functions of the nerves of the skin; Professor Hensen of Kiel, the question whether the doctrine of heredity is to be included in a course in physiology; Professor Kronecker of Berlin, the present state of the knowledge of deglutition; Dr. Openchowski of Dorpat, the automatic, reflex, and inhibitory motions of the cardia of the stomach; and Prof. P. L. Panum of Copenhagen, the slender intestinal fistule for physiological researches.

—Among recent deaths, we note those of Mr. G. H. Boutigny, the physicist, on the 17th of March, at Paris; Dr. T. A. Moesta, on the 9th of April, at Marburg; Dr. J. Bachmann, professor of geology at Berne, at that place early in April; John Williamson of Louisville, Ky., at the White Sulphur Springs, June 16; Prof. J. H. R. Goeppert, who made a special study of fossil plants, on the 18th of May, at Breslau, in his eighty-fourth year; Don Eulogio Jiminez, a prominent Spanish mathematician, at Madrid; Prof. C. Moesta, formerly director of the observatory at Santiago, Chile, at Dresden, on the 2d of April, at fifty-nine years of age; Professor Schoedler, author of Buch der natur, at Mainz, April 27; and Prof. G. von Boguslawski, editor of the *Annalen der hydrographie*, at Berlin, May 4; Henry Watts, the well-known editor of the Watts Dictionary of chemistry, June 30, in his seventieth year.

— The ethnological sub-commitee at Berlin has again engaged Capt. J. A. Jacobson for a long expedition through Russia and Siberia, and also through the Amur region to the Pacific coast. Capt. Jacobson, who only a few months ago returned from a two and a half years' journey through Alaska and northwest America, whence he brought a collection of eight thousand objects, will start very soon. After he has made this journey, he intends to go to British Columbia, and enter again the service of the animal-merchant, Carl Hagenbeck, at Hamburg, for whom he has made several journeys before, through Lapland, Greenland, and Labrador.

— The annual meeting of the Entomological club of the American association for the advancement of science will be held in a parlor of Hotel Lafayette, Philadelphia, commencing at two P.M., Wednesday, Sept. 3. In accordance with the rules of the club, the meeting is called the day before the opening of the general meeting of the association. Entomologists who desire to read communications are requested to notify, as early as Aug. 15, either Dr. D. S. Kellicott, president, Buffalo, N.Y., or Mr. O. S. Westcott, secretary, Maywood, Ill.

— To increase the interest in the work of the chemical section of the American association, the chairman of the section, Prof. J. W. Langley of Ann Arbor, has suggested that one or more subjects be brought up for special discussion, and, with the hope that others may be suggested by the members, has issued a circular, in which he puts forward the following as probably offering good opportunity for debate: 1°. To what extent is the hypothesis of 'valence,' or 'atomicity,' of value in explaining chemical reactions? 2°. What is the best initiatory course of work for students entering upon laboratory practice? 3°. What is the best method for determining phosphoric acid? 4°. To what extent is the 'influence of mass' of practical importance in analytical operations? If the choice of a majority of the section falls on one or two topics, Professor Langley will have the titles put upon the Philadelphia announcements.

— As an improvement of the meteorological service on the coast of eastern Asia, a meteorological and astronomical station has been established at Hong-Kong, on the peninsula Kaulun, opposite the city. Hitherto the observatory at Manila warned the port of Hong-Kong when a typhoon approached.

SCIENCE.

FRIDAY, JULY 25, 1884.

COMMENT AND CRITICISM.

THE long uncertainty has been ended sooner than could reasonably have been expected. Greely and the remnant of his party have been rescued from imminent death. The energy, boldness, and judgment of our naval officers have triumphed over all obstacles; and, in spite of inexperience in such work, complete success has been attained. With the enfeebled survivors were rescued the complete records of the work at the station, such instruments as were originally taken from Lady Franklin Bay, and the mortal remains of those who had succumbed, except a few who had become the prey of winds and currents.

The party accomplished all that they were sent to do, and much more, without loss of life, serious accident or disease, to any of its members. Making a successful retreat with records, instruments, and all hands, to a point where a sufficient store to have carried them through the winter should have been in waiting for them, and where it is even probable a vessel might have safely rescued them in the autumn of 1883, it was their fate to suffer and die from causes due largely to the ignorance and incompetency of others. Fortunately it is not our duty to allot the blame, or specify the acts, or failures to act, which brought about the disaster. It will, without doubt, form the subject of official inquiry, to which it may safely be left. Meanwhile the victims of stupidity are charged by the great mass of sympathizers to the account of arctic exploration.

In this journal (No. 60) we stated that it was probable that Greely started southward from Lady Franklin Bay in July or August, 1883; that the members of the party were living and in good health at that time; that a successful retreat to Cape Sabine would depend upon the opportunity of using their boats; that it was impossible for them to carry more than five or six months' provisions south with them; that it did not seem likely that there were provisions enough at Cape Sabine to carry them through the winter; that they would probably be found at Cape Sabine when navigation opened in 1884; that the prospect of the party reaching the eastern side of Smith Sound was almost unworthy of serious consideration; and that the programme which would waste the time of the relief-ships on the east side of Smith Sound was open to severe criticism. The remarkable manner in which these conclusions (which merely voiced the general opinion of accessible arctic experts) have been justified by the facts is worthy the consideration of those who consider arctic travel a matter of luck rather than of study and experience.

The geographical results of Greely's work are detailed elsewhere in this issue. The most interesting to geographers are the details in regard to the form of the western part of Grinnell Land and the physical features of that area, and the discovery of abundant game and recent Eskimo traces in its northern part. The additions to the shore-line of North Greenland are also very welcome, though the practical proof of the insularity of that continent had been already given by Bessels in his discussion of the Greenland tides. The reaching by Lockwood and Brainard of the highest northern latitude yet attained appeals strongly to American sentiment. The story of heroic endeavor, and patient, loyal endurance, will be heard with kindling hearts and filling eyes by the brave and enterprising of all nations, while universal sympathy goes forth to those whose best and dearest heroically met their fate, as their last faint breath went out beneath the cold gray arctic sky.

When the announcements were made of the honorary degrees conferred at the tercentenary celebration of the University of Edinburgh, some surprise was felt that American men of science appeared to be forgotten, while American physicians and theologians were selected with obvious discrimination for their academic distinctions. It is now stated that the authorities at Edinburgh intimated to several Americans devoted to science, that the university would confer upon them the degree of doctor of laws if they would come and receive it, and that, in case of their non-attendance this year, they might be admitted to the honor if present on some future occasion. The list of men thus chosen may not be authentic, and we shall therefore refrain from reprinting it; but, as given in the newspapers, it includes, among others, a geologist and zoölogist, a botanist, an astronomer, and a philologist, every one of whom would be acknowledged in this country as a worthy representative of American science.

There is fine opportunity to make the coming electric exhibition in Philadelphia a public educator as well as a brilliant display by giving due care to the explanation of the different groups of exhibits. Only a very small share of the visitors to such exhibitions understand what they see; but by far the greater number would gladly learn more than they know if the way were open. The untaught majority of the visitors may wonder and admire, but they really learn very little. Their curiosity is excited, but their reason is not satisfied. Printed explanations are seldom given: verbal explanations are often too technical to be of much value, even when the exhibiters can be found, and are willing to tell their story for the hundredth time.

This might all be changed, if an extended series of well-considered explanatory cards were composed with the special object of reaching the most elementary inquiry, and arranged in such succession that the visitors who follow around the aisles in proper order should read a concise statement of the elements essential to the various contrivances in the bewildering display. Take, for example, the batteries, which will surely be exhibited in large variety. At the beginning of this class of exhibits, there should be a large card on which should appear some such statement as the following: "The essential elements of a battery are so and so; these essentials are reached in various ways, thus and thus and thus." Then in further explanation of the different kinds of batteries, which should be classified as rationally and as distinctly as possible, the advantages claimed for each class could be appropriately defined, as cheapness, durability, intensity, constancy, etc.; or the special object in view might be stated, and the peculiar means to this end briefly set forth.

There would be a double gain accomplished by such a method. The direct gain would be a distinctly better understanding of the exhibition among the many intelligent visitors who were not especially informed on electrical matters. The indirect gain would be a step in general education, in the recognition of the relation between the essentials of an apparatus and the contrivances by which they are attained. For most persons the contrivances are of small importance: they cannot be remembered, except in a few cases where peculiar reasons may give them special interest. But the essentials, the principles of construction freed from the details, are of the greatest service to all. The time and work required for the preparation of such guide-cards would be great, but the public would consider them well expended.

LETTERS TO THE EDITOR.

Cretaceous phosphates in Alabama.

In a previous letter I announced the occurrence of phosphates in the lower beds of the rotten limestone of the cretaceous formation of Alabama. I have since discovered that they are by no means confined to this horizon.

Immediately overlying the rotten limestone, and forming the uppermost strata of the cretaceous formation, are beds of marls and clays, alternating with hard, crystalline, sandy limestones, usually assigned to the Ripley group of Professor Hilgard. Specimens examined from many localities show that these beds in Alabama, from Livingston in Sumter county, eastward nearly to the Georgia line, are very generally phosphatic.

material from this horizon, which has been ned by me, consists, 1°, of marls — either cal-s clay marls, or light chalky marls — composed, main, of carbonate of lime (the few analyses se marls which have been made, show an aver-ntent of about five per cent of phosphoric acid; ccur across the whole width of the state, and many instances, in very good condition for ing upon the land: a marl of this kind at pa has already been used with very fine results); limestone rock, usually crystalline, hard, and mes sandy, but occasionally soft and crum-in one locality the calcareous matter has been d out, leaving a porous sandstone: this lime-which is the Ripley limestone, holds from ten een per cent of phosphoric acid, and extends ly across the state: the aggregate amount of horic acid contained in it is enormous; 3°, lular or concretionary masses of phosphate of and nuclei or casts of gasteropods, bivalves, i, baculites, etc.; these, wherever examined, r to be nearly pure phosphate of lime, but are in comparatively limited quantities: not more alf a dozen quantitative analyses have yet been of the phosphatic material from these beds; but, king the qualitative tests, I have always used quantities of the different substances, and have een able to form some estimate of their com-ve value.

outcrops of the phosphatic beds occurring at ase of the rotten limestone, already described former letter, pass near the following places, asant Ridge, Eutaw, Greensboro, Hamburg, Prattville, Wetumpka, Tuskegee, and Society — while the beds now described above, outcrop a line about thirty miles south of the former, g through or near the following places, — Liv-n, Coatopa, Moscow, Dayton, Prairie Bluff, r Station, Fort Deposit, Union Springs, Flora, he one line of outcrop being along the northern r of the 'prairie region,' the other along its ern border.

, further, an interesting fact that the upper beds rotten limestone itself are phosphatic. I ex-d recently the outcropping limestone from gston for six miles northward, and in every case it to be more or less phosphatic; and in a few I found *nodular* phosphates in small quantity. er localities, as at Boligee, and between New-and Uniontown, at a distance from either r of the rotten limestone, occur phosphatized of shells. I have not yet had the opportunity amining the strata at these places, and cannot, ore, say whether or not the phosphates are con-to these nuclei, but am inclined to think that hatized strata occur at intervals through the thickness of the rotten limestone, as well as at e and summit.

ether any of these phosphates may be profitably d to distant points or not, it is certain, that, in osphatic marls and greensands, our farmers, in prairie region' at least, have the materials for ing the fertility of their soils at a comparatively cost.

EUGENE A. SMITH.

ersity of Alabama, July 12.

Swarming insects.

m not a properly qualified reporter of scientific , but the following observations have interested —

at on the doorsteps of 626 Euclid Avenue some ago, watching the 'Canada soldiers,' of which gnat-like looking insect I enclose a specimen. They filled the air. They were absolutely myriads. The north wind, I am told, brings them from over the lake; but they are ephemeral, and their dead bodies are almost as numerous on the pavements as their live bodies in the air.

As I sat watching their flight, my attention was attracted to a singular smoke-like appearance on the top of a tall elm which stood at the edge of the street-curb. From the topmost branches of this tree rose vertically into the air four or five waving, flickering tongues of what at first looked like smoke. To describe their peculiar lambent motion, I can think of nothing better than the 'cloven tongues of fire' mentioned in the 'Acts of the apostles;' or the darting, flashing spires of the aurora borealis, only the color was smoky, not fiery. I give a rude delineation. The

waving, playing motion of these smoky spires is simply indescribable. They would fade and re-appear, wave back and forth as if swayed by the wind, mount higher and higher, until sometimes one would leap up twenty, thirty, or forty feet into the air. The *look* was as if the tree was smoking, the thin wiry columns of smoke streaming up into the sky. Closer examination disclosed the fact that these pillars of smoke in the evening twilight were really columns of winged insects, but whether the 'Canada soldiers,' or a smaller insect, I could not see; and inquiry elicited the further fact that this phenomenon is not exceptional. Perhaps it has already been noted in your journal, but I venture to send you this brief and imperfect account of it. A Cleveland resident, to whom I have read this, is quite confident that it was a smaller insect which was thus disporting itself.

EDWARD ABBOTT.

Cleveland, O., July 9.

[The 'Canada soldier' sent is a large ephemerid, found in immense numbers about the Great Lakes. The pulsating swarms of small insects seen about the tree-top were undoubtedly formed of gnats (Chironomidae), allied to the mosquitoes. The phenomenon has been frequently witnessed, both in this country and in Europe, to the great astonishment of the spectators. — ED.]

THE ORGANIZATION OF AN INTERNATIONAL SCIENTIFIC ASSOCIATION.

SEVERAL months ago *Science* published an editorial on the proposed foundation of an International scientific association. Since that first public announcement of the project, interest in it has deepened and spread. There is now in circulation, for additional signatures, a request supported by some of the leading scientific men of America, and addressed to the two national associations which meet on our side of the ocean this year. This request is to the effect that the two bodies shall consider the advisability of forming an international association: it is therefore appropriate to consider the grounds upon which we may advocate the execution of the proposal.

There are many persons who have long held the conviction that some regular opportunity for international intercourse between scientific men, bringing them from all countries into personal contact with one another, would be equally useful and pleasant. The only feasible manner yet suggested, so far as I am aware, of insuring the desired opportunities, is to establish an international society after the general type of the national associations and the international congresses, such as the medical, geological, etc., — organizations which have already justified their existence by the good they have accomplished. It is believed that the time has now come for extending habitual scientific co-operation beyond the limits of each country, to all those that are active in the promotion of science. Moreover, the manifold sciences of the present have so many common interests, that the welfare of each is inseparable from the welfare of all; and therefore, when they all unite for the common good, will the highest purposes of knowledge be best served. This it is which renders a general scientific congress more advisable than a number of special ones. The body of wider purpose would also represent more fitly the full dignity of science.

What advantages may be expected from the proposed International scientific association? Foremost must be placed, I think, the opportunities for personal intercourse between men of the same interests, but who, living in countries wide apart, would otherwise never meet. Experience amply demonstrates the reality of the interest and advantage of contact, direct and immediate, of mind to mind, which affords an insight into another's way of thought otherwise impossible. This is because conversation enables one to get by a short cut to the pith of thought, and to secure an explanation of just whatever has been obscure in the conceptions of another. The action of others' minds becomes understood as it never can be from books. New points of view open up, and the error of the personal equation is diminished. Another advantage must be sought in the meeting of specialists of different branches, who mutually inform one another of the living interests of each other's science. The importance of the actual sessions lies in the discoveries and discussions filling them, and is so well recognized that this allusion is sufficient. As the association will have great dignity and high standing in all countries, it will be appropriate for it to undertake the adjustment of many of the international interests of science, such as the unification of standards, and other affairs requiring the concerted action of separate nations. The establishment of uniformity the world over, in many matters, may certainly be more authoritatively made through the medium of a representative congress of scientific men of all nations than by any other means.

As regards the special occasion of founding the new organization, the advocates of doing so in America this summer maintain that another opportunity is not likely to soon re-occur so favorable as will be afforded by the meeting of the British association in Canada, followed immediately by that of the American association in Pennsylvania. If the scheme is carried out, it will, in fact, be the legitimate and anticipated culmination of a movement of which the coming to America of the British association is one part. In 1881 the proposal was made that the American association invite the British to America. This was actively discussed; and finally it was determined — largely,

I believe, from motives of real modesty — to postpone the invitation, and issue instead a large number of special requests to individuals to attend from abroad the meeting of our association at Montreal. This duty fell to the local committee of Montreal in 1882. The large number of foreign visitors who came revived the hope that the British association could be induced to come over as a body. The matter was then independently taken up by the Canadians, and pushed generously and eagerly towards the great success which every one now anticipates for the gathering at Montreal. From the first it has been understood, that if the original enterprise, which was in many ways so full of difficulty, should be brought to a successful issue, then the still greater enterprise should be broached, and the foundation of a permanent international association be attempted.

It is hoped that the British association will take some action in the matter. It has been suggested that a committee with powers might be appointed to confer with the American association at Philadelphia. The organization of the latter body is such that no further official action on its part is possible until the time of meeting itself; but there can be no doubt as to the cordiality with which any proposal emanating from the British association will be received. At present no definite plans have been formed, as it has been felt that public discussion was necessary before making any decision; but, as it is advisable to gather as many suggestions beforehand as possible, I shall be glad to correspond with any one interested in the proposal.[1]

CHARLES S. MINOT.

[1] [Dr. Minot's address is 25 Mt. Vernon St., Boston, Mass. —ED.]

THE IMPLEMENTS OF THE IGLOO.

IN my former article on the igloo of the Innuit, published in *Science* last August and September, I said, in closing, "I should like to give a few brief descriptions of those appurtenances that might be strictly called igloo accessories, as the native stone lamp and kettle, the well to fresh water through the thick ice beside the snow-hut, and many other minor items all growing out of the igloo itself; but this article has already grown to such dimensions that they must be laid aside." A letter from the editor, requesting to know more about the life of the Eskimos among whom I was thrown, has induced me to take up my abandoned subject as an appendix to my former article about the igloo itself.

The snow-stick, called by the Eskimos ah-now′-tuk, is a constant companion of the igloo, and is used to knock the snow off of the reindeer clothes or bedding, when by any chance it has gotten on them. After the igloos are built, when camping on a sledge-journey, the reindeer-skins that are to form the bedding are given a beating with the ah-now-tuk as they are taken from the sledge, before being put in the snow-house; and this beating must be very thorough if there has been a high wind with drifting snow during the day, or the sledge has upset, or any mishap has occurred to fill the hair with snow or ice. When a hunter comes into an igloo from the chase or a journey, he takes off his outer reindeer-coat (coo′-le-tah) and outer trousers (kok′-liks), both with their hair turned *outwards;* and, if there be any snow or ice on them, a few dexterous strokes with the snow-stick soon rids them of it, when they are carefully rolled up and put at the foot of the bed, or, if the native is going to retire for the night, under his head as a pillow. When severe exercise brings on profuse perspiration, this is taken up by the inner reindeer-clothes, with their hair turned *inwards*, in the shape of an evenly distributed moisture, which, in thick fur especially, seldom reaches to the skin itself; and, when these clothes are taken off for the night, this freezes into a hoar-frost-like covering, which is beaten off by the ah-now-tuk in the morning, before they are resumed. Sometimes it is impossible to thoroughly get rid of this sabulous ice, and nothing is more disagreeable to an explorer than to crawl out of a warm sleeping-bag in the morning, and crawl into this powdery ice still clinging to the fur of the inner clothes; but there is nothing to be done but to grin and bear it for the few short minutes it takes to warm the fur with the bare skin of the body.

The ah-now-tuk itself can be any sort of handy club that one can wield with the right hand, while the clothes, bedding, etc., are held in the left:[1] but there is usually a particular

[1] I have spoken of the Innuit as *right-handed*. In connection with this remark, I think it would not be uninteresting to reproduce a small portion of my address before the New-York academy of sciences, Nov. 1, 1880, relating to the ambidexterity of the Innuit. I there said, "I have often been impressed with the

form made by the more industrious ones, that I have tried to represent in fig. 1; for, when ordinary sticks are used, it is in the most shiftless igloos and abject families, about whom nothing

FIG. 1.

can be taken as typical. It is bluntly 'edged,' as shown in cross-section in fig. 1; and this facilitates the pounding-out of the snow where it has been deeply embedded by a strong wind, or ice which has frozen into the fur. They are generally made of hard wood (fig. 2), procured from the traders or whalers; but I understand, that, in intensely cold weather, oak or hickory is more liable to break than pine or spruce. When wood is very scarce, they are sometimes made of bone. Fig. 3 rudely represents one in the possession of the author, made by the Netschilluks in and around King William's Land, from the shin-bone of a reindeer, carved with grooves in the handle to fit the fingers. Oftentimes both wood and bone ah-now-tuks are carved into fanciful designs or figures, — an art for which the Innuits are so well celebrated. Sometimes, when the snow rests lightly on the garments to be cleaned, a glove is taken from the hand and used as an ah-now-tuk, especially where large, heavy bear-skin gloves are worn, — such as, I understand from Lieut. Ray, the Point Barrow natives use altogether. But it is easy to see

FIG. 2. — SNOW-STICK MADE FROM THE WOOD OF FRANKLIN'S SHIPS.

that they cannot compare in efficacy with the true snow-stick, especially where ice and snow are clogged into the fur; for I have seen a reindeer-coat, soaked in water and covered with solid ice when frozen, rid of this so as to be no longer noticeable to the eye, by an Innuit's ap-

FIG. 3.

plication of the ah-now-tuk. It usually takes about two or three minutes to clean a coat; but, when the sledges have been out all day in a severe storm, half an hour is nothing unusual in cleaning every thing made of reindeer-skin. I have already hinted at one use of the snow-stick in my previous article, when the woman of the household would belabor the intruding dogs over the nose; and it is occasionally employed by the lords of creation in correcting their spouses, although I think I can say that such instances are more rare than among equally ignorant people of civilized countries.

The ice-chisel and ice-scoop, called by the Eskimos too′-oke and e′-lowt, are used in digging through the ice on a lake to get to fresh water. Going into camp near a lake or river, one or two persons, usually nearly grown boys, are sent out on the ice to dig a hole to get fresh water; for, if snow or ice have to be melted, a quantity of oil is consumed, and the warm meal is usually delayed about half or three-quarters of an hour thereby. The first thing to be done is to be sure and select a place that is not frozen to the bottom. In a hilly country, with steep granitic, trap, or similar banks to the lakes or rivers, any place will do. Wherever sedimentary deposits occur, more caution is needed. In a river the native is not a bad judge of the places where he will find the swiftest currents even under the ice, and here he knows that the glacial covering is the thinnest. Any snow banks or drifts that have been formed by the wind before the temperature in the winter reached its minimum, will give thinner ice, and consequently less work; for the snow can be shov-

ambidexterity of the various Eskimo tribes with whom I have come in contact, those not possessing this functional symmetry being rare exceptions to a general rule; and even in those, the superiority of dexterity over *gaucherie* is not so well marked as in their more civilized brethren. They drive their dogs, using their whip indifferently with either hand. They shoot their game indifferently from either shoulder, skinning and carving their carcasses without regard to the particular hand employed. In the most delicate and complicated tasks that they undertake, the use of one hand only is imposed until it is fatigued, when it is freely exchanged for the other. Assuming the simple-minded Innuit to be low in the ethnological scale, these facts might support the theory, so ably advanced by Dr. Daniel Wilson of Toronto, that the primitive condition of man and other vertebrates was, as their early foetal condition still is, one of complete bilateral symmetry, not only structural, but also functional."

elled off in two or three minutes, even from the deepest drifts. If these drifts should be covered with a crust, the native at once knows

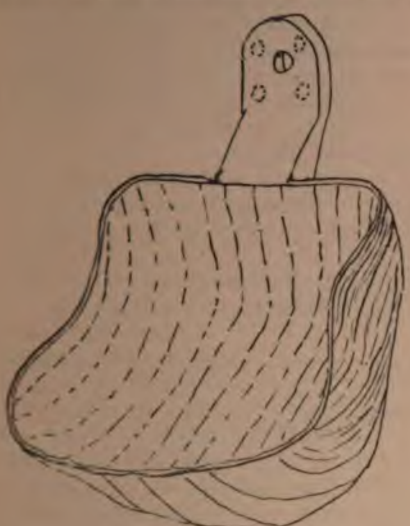


FIG. 4.

that they were formed during the October or November thaw, before the ice could have been very thick; and a couple of feet of drift will save him digging through nearly double

FIG. 5.

that amount of ice. And with many of those savage traits bordering on instinct, he can closely judge about the age of the drift; for, if made since the coldest weather, it has been no protection to the ice-covering, and only adds the labor of removing it, slight as it is. Where there is no covering to the clear blue ice, you will often see them extended full length, their little pug noses pressed against it; for they can, by varying peculiarities of the hues, tell if it be frozen to the bottom, or not. The site selected by all these conditions duly weighed, the operation is commenced by starting a hole about a foot and a half in diameter, and probably a foot deep, with the ice-chisel. In cutting with this, the ice has been broken up into small fragments; and these are taken out with the ice-scoop, and this alternation kept up until water is reached. The ice-scoop is the native ladle of musk-ox horn, firmly attached to a pole from eight to ten feet long (fig. 6, *b*). This ladle is made from the splayed base of the horn of the musk-ox. Fig. 4 represents one in the author's possession. Fig. 5 is taken from Hall's 'Narrative of the second arctic expedition.' Ordinarily they subserve the purpose of a tin cup, or similar utensil, and hold from a pint to nearly two quarts. When used for an e-lowt, four holes are bored in the heavy handle (as shown in fig. 4), and through these the ladle is lashed to the pole by sinew (fig. 7).

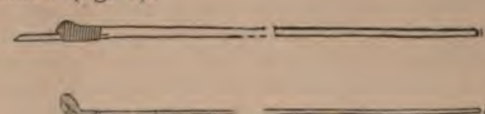


FIG. 6.

The ice-chisel (fig. 6, *a*) is any cutting instrument, like a bayonet, sabre-point, or sharpened iron, a mortising-chisel being the best, on a similar pole to that of the scoop. The Ookjooliks and Netschilluks used iron spikes from Sir John Franklin's ships. Usually it swells out near the butt, where it is lashed to the chisel; and the main object of this, besides giving securer lashings, is when the last few strokes are made, that let the water from beneath into the ice-well, with four or five as powerful and rapid thrusts as the digger can make. This projection knocks the lower rim of ice off, and keeps the well a uniform width throughout, — an important item, for through this hole many a meal of salmon may be caught. These last strokes must be very rapid;

FIG. 7.

for, when the water starts into the well from such a depth, it comes apparently with the force of a fire-engine; and, once a foot or two deep,

the ice-chisel can no longer be worked. I have often seen the water come up the well with such impetuosity that it would overflow the ice where the ice-digger was standing, then sink a couple of feet in the well, and keep pulsating for five or ten minutes before coming to an equilibrium, generally about two to three inches from the upper ice-level. Besides the purpose of fresh water for cooking and drinking at a camp, the native sledgeman, if the ice be ripped from his sledge-runner by stones or ice while on a journey, will stop and dig through six or seven feet of ice to re-ice this part of his sledge — so important is it, if his vehicle be heavily loaded, or only dragged by a few dogs.

The average ice-wells are about six or seven feet deep. The thickest we had to dig on our King William Land sledge-journey was eight feet four inches; and I very seriously doubt if it ever gets more than a foot or a foot and a half deeper than this on fresh water, in any part of the arctic, where all the ice is melted in the summer. This distance, the natives told me, was the deepest they had ever seen. Of course their judgment can only be approximation, but nevertheless moderately reliable. A six-foot ice-well will be dug usually in about forty to forty-five minutes, although the more active may do it in half that time. If the ice has been much permeated by cracks, by digging on one of these, and especially where two of them cross, one may greatly lessen the time. Another use to which these two instruments are put, extraneous to their usual purpose, is to stick them upright in the snow at a camping-igloo, and on their tops the dog-harnesses, which, if made of seal-skin or any kind of skin, are liable to be devoured by their wearers when unusually hungry; and this position, eight or ten feet in the air, is a very safe place for them for the night. A native sledgeman, driving through rough, hummocky ice, often uses the ice-chisel to clear his way, and will make the angular ice in front of him disappear in a manner most astonishing. When one ice-well has been unsuccessful (that is, when the ice extends to the bottom), they may melt ice if they have plenty of oil: for by that time the igloo may be completed, and the lamp burning, although generally they can and do dig two by that time; and I have known cases where they were extremely anxious to economize oil, and six or seven wells were dug before they gave it up or were successful. It is very astonishing how soon they can tell whether the well is going to be a failure; the merest pinch of earth, way down in its depth of five or six feet, instantly arresting their eye, when the same would hardly be distinguishable on the surface, to the ordinary eye. That very instant they stop digging; for many of them are as careful of the edges of their ice-chisels as a man is of his razor.

The implements used in the construction of the igloo, the snow-knife and snow-shovel, have already been described in the article on the igloo.

The cooking-implements consist of the stone kettle (oo-quee′-sik) and stone lamp (kood′-lik), so often described by arctic travellers; and for that reason I will only dwell upon them briefly. They are described by Surgeon Fisher, of Parry's first expedition, as made of *lapis allaris*, or pot-stone. Dr. Hayes not inaptly compares the lamp, in shape, to a clam-shell; and, if the shell only had a slightly straighter edge, the comparison would be very good. Fig. 8 represents an outline view of one standing on the usual three sticks stuck in the snow-platform in front of the snow-bed, *a b* indicating the edge along which the flame is lighted. These lamps usually hold from half a pint to two or three quarts of oil, so variable are they in size; and this oil, when the lamp is properly adjusted by the rear stick, just touches the edge *a b*, along which there is placed a species of compact moss, that has been thoroughly dried, and rolled in the two open palms (as a sailor would prepare his pipe of tobacco) with a small quantity of fat, and lighted. This moss must be kept dense, or the lamp, with its six to thirty inches of flame along this edge, will smoke beyond endurance; and this is done with a small stick of hard wood a little larger than a pencil. This 'trimming' of the lamps is quite an accomplishment,

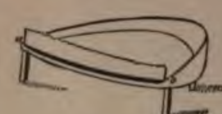


FIG. 8.

FIG. 9.

and only reaches perfection in the old women of the tribe, some of whom can prepare a lamp so that it will give a good steady flame for several hours, while usually half an hour is the best that can be expected. They are constantly broken; and those I saw thus injured were cemented with a mixture of blood, clay, and hair, according to the Innuits, although I

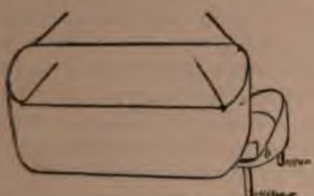


FIG. 10.

could not verify the mixture by watching the operation. Fig. 9 is a good view of a lamp (from Hall's 'Narrative of the second arctic expedition') that has been broken, and repaired by sinew; and, although I do not now recall any such mending, I should think it better than the other, although, as far as I could see, the first way was so perfect that new cracks would form directly beside the old, but not in it; and I suppose that the one mentioned by Hall may have had this cement in addition to the sewing, in order that it should hold oil. Heavy as it is, the natives carry it with them everywhere; and I hardly know of any thing in civilization that could effectually replace it, were they even inclined to do so. Its constant companion is the stone kettle, which is nothing more nor

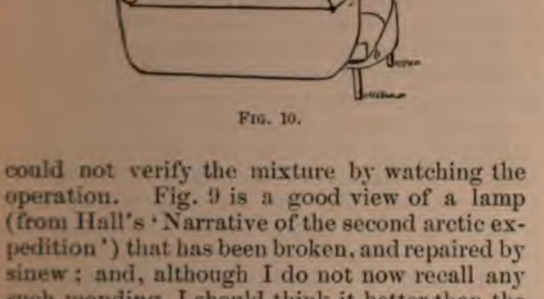


FIG. 11.

less than a rectangular vessel (fig. 10), holding from a quart to a gallon, whose flat bottom is a little shorter than the flame of the lamp directly over which it swings, so that the flame just touches its bottom. It is superior, for their use, to brass, copper, or sheet-iron vessels of any shape, and has seldom been replaced by them, even when these could be readily had; and the few cases I know have been unwilling ones. It suffers the same mishaps in breakage, mendings, and journeys, as its constant fellow the lamp, to which it is suited in size, and from which it is seldom parted. Over a framework of long wooden sticks, thrust through the side of the igloo if horizontal, or into the snow-platform if perpendicular, is laid a bent piece of wood or a barrel-hoop (fig. 11), across which is woven in rough design a number of sinew strings, forming a network; and on this net are laid the reindeer stockings and gloves, and every thing, in fact, that is required to be warmed or dried. This net can always be found in every igloo, and hanging from every sledge that is transporting household effects.

The seal-skin bucket (fig. 12) holds from two quarts to double as many gallons, and is generally made large, so that its contents will not freeze solid during the night. It is made of seal-skin (the smaller hair-seal), tanned so as to be deprived of the hair, and furnished with a handle of the same material sewed on. It always bulges out on one side into a sort of spout, where, by constant use in drinking from this place, they have produced it. When empty of water, and clogged with ice (as it usually is when they start to the ice-well to refill it), it is given a vigorous beating over a sledge, a hard snow-drift, or, if in a sportive mood, over a dog's head, the broken ice-splinters flying in every direction, leaving it as limber as a piece of canvas. The im-moo'-sik, or musk-ox ladle, already described as subserving another purpose, and seal-skin bucket, are slowly giving way to the utensils of a similar character of civilization.

FIG. 12.

The reindeer bedding can hardly be treated under this title, and the snow-knife and snow-shovel were described in my former article. The sum total of 'igloo implements' shows them, therefore, to agree in simplicity and small numbers with all other implements with which the people wrest an existence from a niggardly nature.

FREDERICK SCHWATKA,
Lieut. U. S. army.

COUES'S KEY TO NORTH-AMERICAN BIRDS.

Key to North-American birds. Containing a concise account of every species of living and fossil bird at present known, from the continent north of the Mexican and United-States boundary, inclusive of Greenland. By Elliott Coues. 2d ed. Boston, *Estes & Lauriat*, 1884. 30+863 p., 561 fig. 8°.

The original edition of the 'Key,' published in 1872, consisting of three hundred and sixty-one imperial octavo pages and two hundred and thirty-eight woodcuts, is well known to all students of American birds. The present edition is not only 'entirely rewritten,' but contains nearly four times as much matter, and more than twice as many illustrations, as the first; yet in bulk the work is scarcely larger, being printed on thinner paper and in smaller type. While most of the old illustrations have been retained, many have been replaced by better ones, nearly one-half are added from the author's previous works and other published sources, while some fifty or more have been engraved expressly for this edition. While the old 'Key' has proved eminently useful, it was not without its defects, owing mainly to extreme conciseness of treatment. The present 'Key' is modelled on the plan of the old, and written in the same spirit, but is the same mainly in title.

The work opens with an 'historical preface,' occupying some sixteen pages, in which is felicitously sketched the history of North-American ornithology from its earliest beginning nearly to the date of the first edition of the 'Key.' The history is divided into 'epochs' and 'periods;' and the influence various writers have had upon the progress of the subject is judiciously weighed, and thrown into strong relief. Then follows the preface proper, in which the author explains the differences between the present edition and the earlier one, and makes his acknowledgments of aid, in the preparation of the work, received from various persons and sources.

The work proper is divided into four 'parts.' Part i. (pp. 1–58) is entitled 'Field ornithology,' and forms a manual of instruction for collecting, preparing, and preserving birds. This is a nearly verbatim reprint of a separate work having this title, published by the author in 1874, and already well known as a work of great practical usefulness to collectors. Part ii., 'General ornithology,' is devoted to an elementary exposition of the structure and classification of birds, and occupies pp. 59–236. It (1) defines birds as distinguished from other vertebrates, (2) discusses the principles of classification and their application, (3) gives definitions and descriptions of the exterior parts of birds, and (4) devotes nearly one hundred pages to the anatomy of birds, giving a general outline of the subject. Part ii. is very fully illustrated with well-chosen figures. The portion of the text devoted to the anatomy of birds is entirely new, and suffices to give very fairly the rudiments of the subject, which is all the author attempts. Many of the figures are drawn from nature by Dr. Shufeldt expressly for the work: others are after Parker, Huxley, and other well-known authorities. This part closes with artificial keys to the orders, sub-orders, and families. The attempt made in the old 'Key' to carry the student at once to the genera is here abandoned.

Part iii. (pp. 237–820), devoted to a 'Systematic synopsis of North-American birds,' forms, of course, the main body of the work. It describes all the species and sub-species, and defines the genera and higher groups of North-American birds. The descriptions are much amplified from those given in the first edition, but with the idea still in view of sharp definition. The references to authorities previously given are omitted, perhaps not unwisely; and in their place we find an epitome of the life-history of the species, with special reference to their nesting-habits, song, flight, and migrations. These display at its best the author's happy knack of hitting in few words a bird's leading and characteristic traits. More space is also given to an account of the geographical distribution of the various species and races, and the plumages of female and immature birds are more fully and much more satisfactorily indicated. An artificial key to the genera is given under each sub-family, and the species are analyzed under the genera. The matter given under each species is apparently about four to six times greater than in the old 'Key,' and is sufficient to give in satisfactory detail, not only its technical characters, but a glimpse at the *rôle* it plays in life. The number of species and sub-species treated is eight hundred and ninety-nine, which are placed under three hundred and forty-nine genera. The technical names are marked for accent, and they are also etymologically defined.

Part iv. (pp. 821–830) is devoted to a 'Systematic synopsis of the fossil birds of North America,' numbering forty-six species. Of these, twenty-five are tertiary (sixteen being referred to living genera), twenty cretaceous, and one Jurassic. This part, the author tells us, has been revised by Professor Marsh.

The classification adopted is at some points radically different from that employed in the first edition, particularly as regards the primary divisions of the class. The number of 'orders' now adopted for North-American birds, which belong all to the 'sub-class' Carinatae, is thirteen, subdivided into twenty sub-orders, sixty-three families, and seventy-seven subfamilies.

The twelve years which have passed since the appearance of the original edition of the 'Key,' have been marked by a striking increase in our knowledge of North-American birds. This advance would alone render any general work on the subject, published at that date, to some extent antiquated and unsatisfactory, however excellent it may have been in its time. The old 'Key' has unquestionably had a career of usefulness, and has helped on the advance that has so strongly characterized the last decade of North-American ornithology; the object of the treatise being to enable any one, by its aid, to identify his specimens without recourse to other information than that the book itself afforded. The undertaking was to some extent, at least in its methods, an innovation in zoölogy, and, however well it may have served its purpose, was obviously open to improvement, as such attempts must always be. Its defects were doubtless as quickly seen by its author as by others; and to remedy these, and bring the work down to date, the author was led to prepare this much enlarged, and in many ways greatly improved, second edition. The first edition emphasized, and in a large degree initiated, a new departure in respect to the status of many forms of North-American birds, which were degraded from species in regular standing to the grade sub-species or geographical races, and referred, as 'varieties,' to the species from which they were found to be not completely differentiated. Since that time the custom has arisen and become established, among American ornithologists, of discarding the interpolated 'var.' between the varietal and specific names of such forms; and, in accordance with this custom, the new 'Key' adopts the new 'trinomial' nomenclature for such intergrading forms as it seems wise to recognize in nomenclature. The names are, in fact, strictly those of the author's revised 'Check-list,' published in 1882, *plus* about a dozen since added.

As regards paper and typographical execution, the work is all that need be desired; the composition and press-work being that of the Cambridge University press. The author tells us that his publishers generously allowed him 'to make the book to suit himself,' sparing no expense to which they might in consequence be put. While some of the cuts are not above criticism, many of them are fine, so that their average grade is high; and in nearly every case their origin is duly accredited. The work as a whole is certainly very tastefully executed.

WIEDEMANN'S ELECTRICITY.

Die lehre von der elektricität. Von GUSTAV WIEDEMANN. 2 vols. Braunschweig, *Vieweg*, 1882-83. 11+795, 7+1002 p. 8°.

THE work which forms the subject of this notice is the successor to 'Die lehre vom galvanismus und elektromagnetismus,'' by the same author, first published in 1861, and followed by a second edition in 1874. Ever since its publication, the original work has been recognized as a practically exhaustive treatise on the topics included within the limits set by the author. Every discovery and observation is referred to the original publication, and its date is given. These references, so characteristic of the previous work, are continued and extended in the present treatise; and they form a classified index to the literature of electricity with the historical advantage of dates. One is surprised at the extent and range of the literature to which reference is made.

It is a suggestive fact, that a third edition simply of the original work could not represent the present knowledge of galvanic electricity and electromagnetism with that unity and completeness which the author's plan contemplated. The separation between static and galvanic electricity, which obtained up to the middle of the present century, can no longer be maintained: hence Professor Wiedemann wisely decided to extend the scope of his work, and to prepare with immense labor a practically new book under the more comprehensive title of 'Electricity.' This decision must be universally approved; for, aside from the very evident advantage of having a complete treatise in place of a partial one, the present conception of electricity forbids the treatment of the subject under its historical divisions. This division, which seemed imperative twenty-five or thirty years ago, has now become impossible. No fundamental differences between the two classes of electricity, due to different methods of generation, are now recognized. With galvanometers sufficiently sensitive to be affected by static discharges, on the one hand, and with electrometers capable of measuring

with great ease the difference of potential between the poles of a single cell, on the other, it is readily seen that static electricity acquires its predominant but not exclusive character from great difference of potential, while galvanic electricity produces its most striking effects by the transfer of great quantities of electricity as a current. The terms 'static' and 'galvanic' serve only to denote the extremes of electrical phenomena. In fact, the contact theory of potential difference unifies the whole science by giving a common account of the historically diverse forms of static and galvanic electricity; for it is now generally believed that the potential difference in frictional machines is due to contact of dissimilar bodies, while the old contest which began with Volta and Galvani is now set at rest by the happy compromise of assigning electromotive force to contact, and the energy of the current to chemical action.

The first volume of Professor Wiedemann's new work treats of general electrical phenomena, the excitation of electricity by contact of dissimilar bodies, Ohm's law and its consequences, determination of resistance in a great variety of bodies, measurement of electromotive force, and galvanic elements. The second volume is devoted to dielectrics, the theory of frictional and influence machines, the relations between heat and electricity, and to electro-chemistry.

Mathematical treatment of the subject is introduced so far as it serves to establish general principles or theories, and to discuss methods and confirm results. Beyond this, mathematical discussions, which are interesting as mathematical exercises, but which do not advance our knowledge of physical principles, are either omitted entirely, or are referred to by citation.

The applications of electricity are noticed only so far as they serve to give completeness to a scientific knowledge of the subject.

It was reported a year ago that the manuscript of the two concluding volumes was nearly ready for the press.

Professor Wiedemann has placed all physicists under obligations by his full and logical presentation of all the facts and principles of the science of electricity. While the work does not possess the originality of Maxwell's, and is written with an entirely different purpose, it must, nevertheless, be classed with it as one of the great works on electricity. Considered from the point of view of giving a complete account of what is known respecting this branch of physics, and of showing what each investigator has contributed to our common stock of knowledge of electricity, this book is not equalled by any other in any language.

H. S. C.

NOTES AND NEWS.

No piece of news of wider interest has traversed the wires of two continents since *Science* was founded than that which announced last week the rescue of the Greely party. The story of their frightful sufferings, their sad losses, and the successful accomplishment of their duties, is briefly told in the two despatches from Lieut. Greely, which we print in full below. It appears, that, when found, they were huddled in a tent, which the force of the gale had blown down upon them. The strongest of them could hold aloft the signal-flag, to guide the relief-party they could hear but not see, for two brief minutes only; and the weakest begged to be left to die in peace. Their provisions were utterly exhausted, and they had been living for weeks on a stew made from their sealskin clothing, with lichens and small shrimps; and it is highly probable that a detention of the relief-party for two days would have cost the entire party their lives.

The following two despatches from Lieut. Greely were received by the chief signal-officer on July 17: —

Brainard, Bierderbick, Connell, Fredericks, Long, and myself, the sole survivors, arrived to-day, having been rescued at the point of death from starvation by relief-ships Thetis and Bear, June 22, at Camp Clay, north-west of Cape Sabine. All are now in good health, but weak. Sergeant Ellison, who was rescued, died July 8. Cross died last January; Christianson, Linn, Rice, Lockwood, Jewell, and Edwards, in April; Ellis, Rainston, Whisler, Israel, in May; Kingsbury, Salor, Henry, Bender, Pavy, Gardiner, Schneider, in June. Abandoned Fort Conger Aug. 9. Frozen in pack, off Victoria Head, Aug. 29. Abandoned steam-launch, Sept. 11, eleven miles north-east of Cocked Hat Island. When on the point of landing, we were three times driven by south-west storms into Nares Sea. Finally landed, Sept. 29, in Baird Inlet. Learning by scouting-parties of the Proteus disaster, and that no provisions had been left for us from Cape Isabella to Sabine, moved, and established winter quarters at Camp Clay, halfway between Sabine and Cocked Hat. An inventory showed, that by a daily ration of four and one-third ounces of meat, seven of bread and dog-biscuit, and four ounces miscellaneous, the party would have ten days' full rations left for crossing Smith Sound to Littleton Island, March 1. Unfortunately, Smith Sound remained open the entire winter, rendering crossing impossible. Game failed, despite daily hunting, from early in February. Before the sun returned, only five hundred pounds of meats were obtained. This year minute shrimps, seaweed, sassafras, rock-lichens, and sealskin were resorted to for food, with results as shown by the number of survivors. Last regular food issued May 14. Only a hundred and fifty pounds

of meat being left by Garlington, compelled me to send, in November, four men to obtain a hundred and forty-four pounds English meat at Isabella. During the trip, Ellison froze solid both hands and feet, and lost them all; surviving, however, through our terrible winter and spring, until July 8. Survivors owe their lives to the indomitable energy of Capt. Schley and Lieut. Emory, who, preceded by three and accompanied by five whalers, forced their vessels from Upernavik, through Melville Bay, into northwater at Cape York with the foremost whaler. They gained a yard whenever possible, and always held it. Smith Sound was crossed, and our party rescued, during one of the most violent gales I have ever known. The boats were handled only at imminent risk of swamping. Four of us then were unable to walk, and could not have survived exceeding twenty-four hours. Every care and attention were given us. Have saved and bring back copies of meteorological, tidal, astronomical, magnetic, pendulum, and other observations; also pendulum, Yale and standard thermometers, forty-eight photographic negatives, a collection of blanks and photographic proofs. Eskimo relics and other things necessarily abandoned. The Thetis remains here five days probably.

GREELY, *Commanding*.

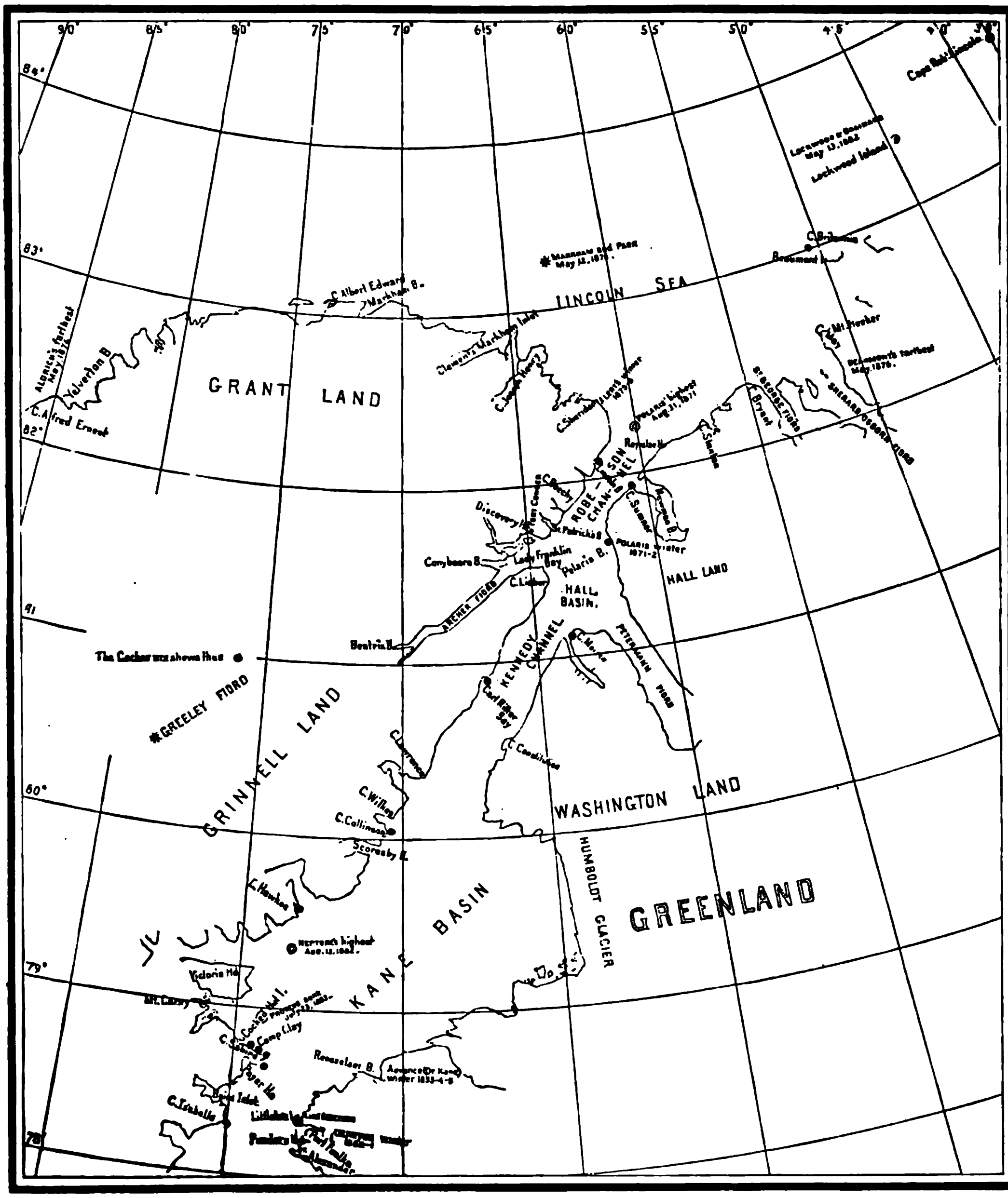
For the first time in three centuries, England yields the honor of the farthest north. Lieut. Lockwood and Sergeant Brainard, May 13, reached Lockwood Island (latitude 83.24°, longitude 44.5°). They saw, from a two thousand feet elevation, no land north or north-west, but, to the north-east, Greenland, Cape Robert Lincoln (latitude 83.35°, longitude 38°). Lieut. Lockwood was turned back, in 1883, by open water on North Greenland shore, the party barely escaping drift into polar ocean. Dr. Pavy, in 1882, following the Markham route, was adrift one day in polar ocean north of Cape Joseph Henry. Escaped to land, abandoning nearly every thing. In 1882 I made a spring, and later a summer, trip into the interior of Grinnell Land, discovering Lake Hazen, some sixty by ten miles in extent, which, fed by ice-caps of North Grinnell Land, drains Ruggles River and Weyprecht Fiord into Conybeare Bay and Archer Fiord. From the summit of Mount Arthur, five thousand feet, the contour of land west of the Conger Mountains convinced me that Grinnell Land tends directly south from Lieut. Aldrich's farthest in 1876. In 1883 Lieut. Lockwood and Sergeant Brainard succeeded in crossing Grinnell Land, and ninety miles from Beatrix Bay, the head of Archer Fiord, struck the head of a fiord from the western sea, temporarily named by Lockwood, Greely Fiord. From the centre of the fiord, in latitude 80.30°, longitude 78.30°, Lieut. Lockwood saw the northern shore termination some twenty miles west, the southern shore extending some fifty miles, with Cape Lockwood some seventy miles distant, apparently a separate land from Grinnell Land. Have named the new land Arthur Land. Lieut. Lockwood followed, going and returning, ice-caps averaging about fifteen feet perpendicular face. It follows that the Grinnell Land interior is ice-capped, with a belt of country some sixty miles wide between the northern and southern ice-caps. In March, 1884, Sergeant Long, while hunting, looked from the north-west side of Mount Carey to Hayes's Sound, seeing on the northern coast three capes westward of the farthest seen by Nares in 1876. The sound extends some twenty miles farther west than shown by the English chart, but is possibly shut in by land, which showed up across the western end. The two-years' station-duties, observations, all explorations, and the retreat to Cape Sabine, were accomplished without loss of life, serious accident, or even severe frost-bites. No scurvy was experienced at Conger, and but one death from it occurred last winter.

GREELY, *Commanding*.

On the same day, Commander Schley addressed the following telegram to the secretary of the navy, which summarizes the action of the relief squadron: —

The Thetis, Bear, and Loch Garry arrived here to-day from West Greenland. All well. Separated from Alert a hundred and fifty miles north during a gale. At nine P.M., June 22, five miles off Cape Sabine, in Smith Sound, Thetis and Bear rescued alive Lieut. A. W. Greely, Sergeant Brainard, Sergeant Fredericks, Sergeant Long, Hospital-Steward Bierderbick, Private Connell, and Sergeant Ellison, — the only survivors of the Lady Franklin Bay expedition. Sergeant Ellison had lost both hands and feet by frost-bite, and died July 6, at Godhaven, three days after amputation, which had become imperative. Seventeen of the twenty-five persons composing this expedition perished by starvation at the point where found. One was drowned while sealing to procure food. Twelve bodies of the dead were rescued, and are now on board the Thetis and Bear. One Eskimo, Turnevik, was burried at Disco in accordance with the desire of the inspector of western Greenland. Five bodies, which were buried in the ice-fort near the camp, were swept away to sea by winds and currents before my arrival, and could not be recovered. The names of the dead recovered, with date of death, are as follows: Sergeant Cross, Jan. 1, 1884; Wederick, Eskimo, April 5; Sergeant Linn, April 6; Lieut. Lockwood, April 9; Sergeant Jewell, April 12; Private Ellis, May 19; Sergeant Rainston, May 23; Private Whisler, May 24; Sergeant Israel, May 27; Lieut. Kingsbury, June 1; Private Henry, June 6; Private Schneider, June 18. The names of the dead buried in the ice-fort, with date of death, where the bodies were not recovered, are as follows: Sergeant Rice, April 6, 1884; Corporal Salem, June 3; Private Bender, June 16; Acting Assistant Surgeon Pavy, June 6; Sergeant Gardiner, June 12, drowned while breaking through the newly-formed ice while sealing; Jans Edwards, Eskimo, April 24. . . .

Greely abandoned Fort Conger Aug. 9, 1883, and reached Baird Inlet Sept. 29 following, with entire party well. Abandoned all his boats, and was adrift for thirty days on ice-floe in Smith Sound. His permanent camp was established Oct. 21, 1883, at the point where he was found. During nine months, his party had to live upon a scant allowance of food brought from Fort Conger, — that cached at Payer



MAP SHOWING POINTS VISITED BY GREELY'S PARTY.

Harbor and Cape Isabella by Sir George Nares in 1875, but found much damaged by lapse of time; that cached by Beebe at Cape Sabine in 1882; and a small amount saved from the wreck of the Proteus in 1883, and landed by Lieuts. Garlington and Colwell on the beach where Greely's party was found camped. When these provisions were consumed, the party was forced to live upon boiled sealskin strips from their sealskin clothing, lichens, and shrimps preserved in good weather, when they were strong enough to make exertion. As thirteen hundred shrimps were required to fill a gallon-measure, the labor was too exhausting to depend upon them to sustain life entirely. The channel between Cape Sabine and Littleton Island did not close, on account of violent gales, all winter; so that two hundred and forty rations at the latter

point could not be reached. All Greely's records, and all the instruments brought by him from Fort Conger, are recovered, and are on board.

From Hare Island to Smith Sound I had a constant and furious struggle with ice in impassable floes. Solid barriers of ice were overcome by watchfulness and patience. No opportunity to advance a mile escaped me; and for several hundred miles the ships were forced to ram their way from lead to lead, through ice varying in thickness from three to six feet, and, when rafted, much greater. The Thetis and Bear reached Cape York June 18, after a passage of twenty-one days in Melville Bay, with the two advance ships of the Dundee whaling-fleet, and continued to Cape Sabine. Returning seven days later, fell in with seven others of this fleet off Wostenholme Island, and announced Greely's rescue to them, that they might not be delayed from their fishing-grounds, nor be tempted into the dangers of Smith Sound in view of the reward of twenty-five thousand dollars offered by Congress. Returning across Melville Bay, fell in with the Alert and Loch Garry off Devil's Thumb, struggling through heavy ice. Commander Coffin did admirably to get along so far with the transports so early in the season, before an opening had occurred. Lieut. Emory, with the Bear, has supported me throughout with great skilfulness and unflinching readiness in accomplishing the great duty of relieving Greely. . . . The Greely party are very much improved since rescue, but their condition was critical in the extreme when found, and for several days after. Forty-eight hours' delay in reaching here would have been fatal to those now living. The season north is late, and the closest for years. Smith Sound was not open when I left Cape Sabine. The winter about Melville Bay was the most severe for twenty years.

This great result is entirely due to the unwearied energy of yourself and the secretary of war in fitting out this expedition for the work it has had the honor to accomplish. W. T. Schley, *Commander*.

From a despatch to the New-York *Herald*, we learn fuller details of the explorations, mostly undertaken by Lockwood and Brainard, to northern Greenland and the interior of Grinnell Land, which are positive additions to geography. The position of Lockwood Island (latitude 83° 24′ 30″ north, longitude 44° 45′ west) was astronomically determined by observations extending over two days; and, in their journey to this point, animal life was found to be abundant, with scant vegetation similar to that met with in Grinnell Land. Traces of hares, lemmings, ptarmigan, and snow-bunting, and the tracks of a bear, were seen, and droppings of the musk-ox as far as twenty miles north of Cape Britannia. The party was absent fifty-nine days. In one of their journeys in the interior of Grinnell Land, Lockwood and Brainard reached its western coast, and looked out on the polar sea. They found an immense glacier, named Agassiz Glacier, forming the ice-cap of southern Grinnell Land, with a belt of land sixty miles wide between it and the northern ice-cap. At the mouth of Greely Fiord they rested three days for observation, and determined their position to be latitude 80° 48′ 39″ north, longitude 78° 26′ west. From a cliff twenty-two hundred feet high, they saw, on a clear day, that in the north the land terminated in a high headland fifty to sixty miles distant, which they called Cape Brainard; and in the south, more distant, they named another headland Cape Lockwood. Beyond this, with open water between, they descried land which they took to be separate from Grinnell Land, and named Arthur Land. Lieut. Greely himself made two journeys into the interior, on which he was absent twelve and nineteen days respectively, and discovered a large body of fresh water, which he named Lake Hazen, fed by streams from the northern ice-cap, and discharging through Ruggles River into Weyprecht Fiord. The river was open at its mouth in April. Winter quarters of Eskimos were found, and some relics showing that they had possessed dogs, sleds, and iron. Two ranges of mountains were found parallel to and beyond the United States range, which he named Conger and Garfield ranges. Greely ascended Mount Arthur, about five thousand feet high, and the highest point in Grinnell Land. Game was found abundant on this journey, a hundred musk-oxen having been seen, with hares and birds.

The return party left Fort Conger with the steam-launch, ice-boat, and two boats in tow, on Aug. 9. The next day they reached Cape Baird, across Lady Franklin Bay. They were frozen for five days in the ice before reaching Cape Lawrence, and gained Cape Hawkes by the 26th, where they took in the provisions left there by the English, and, leaving the same day, had open water for six hours; then the pack closed around them, and they drifted with it, being finally driven to within six miles of Cape Albert, just south of Victoria Head. Here they were obliged to leave the launch and one of the boats; and, making two small sleds from the timber of the launch, they started over the ice for Cape Sabine, eleven miles off, making the slow progress of about a mile a day. On Sept. 13 they had to abandon their last boat, the large sled weakening under it. Twice they were driven back into Kane Basin by south-west gales. Finally the floe, much broken, was driven, on Sept. 22, into the mouth of Baird Inlet, the piece on which they were established being reduced to about fifty yards in diameter. They finally forced a landing on the northern side of the inlet on Sept. 29. The sad prospect before them was speedily discovered by scouting-parties; and, to be nearer the base of their scanty supplies, they made their way northward through a passage to Buchanan Straits (proving Cape Sabine an island), and then eastward along the coast, to where they made their final camp, the advance reaching here Oct. 15. Here they built a hut of stones, roofed with a broken whale-boat and canvas, and banked with snow. This they were compelled to abandon early in May from the moisture from the melting snow, and to occupy the tent higher up the hillside, where the relief-party found them. During the entire winter they had no fuel, except to warm, not cook, their food. As soon as their scanty stock of provisions

was known, they were reduced to a daily allowance of 14.88 ounces each; and this was afterwards still further reduced to 6 ounces, making it last until May 14. During this entire time all the game they obtained was twenty-four small foxes averaging four pounds each, fourteen ptarmigan, and sixty dovekies, excepting a small seal and a bear, killed in April. The last, weighing 257 pounds, undoubtedly saved the lives of the last survivors of the party.

— The managers of the Philadelphia electrical exhibition announce that the buildings are finished, and ready for the preliminary arrangements to accommodate exhibits. The committee urge upon all who have applied for space to begin preparations for installation.

— Dr. Lewis Swift, director of the Warner observatory, has received intelligence of the discovery of a comet by Prof. E. E. Barnard of Nashville, on the night of July 16; and the discovery was verified by the motion of the comet July 20. It is in the head of the Wolf (right ascension 15 hours, 50 minutes, and 30 seconds, declination south 37:10), and is moving slowly in an easterly direction. It seems to be growing brighter, and is probably coming toward the earth. This is the first comet discovered in the northern hemisphere this year.

— From *Nature* we learn that the following are some of the special questions which have been arranged for discussion at the next social science congress, which is to be held at Birmingham on Sept. 17–24: — How far are the requirements of the country for well-trained teachers in elementary schools met by the pupil-teacher system and the existing training colleges? In testing the efficiency of schools, should processes, or 'results,' be chiefly regarded? Health: 1°. What is the best method of dealing with (*a*) town sewage, (*b*) the products of house and street scavenging, and (*c*) the products of combustion? 2°. What are the best means, legislative or other, of securing those improvements in the dwellings of the poor which are essential to the welfare of the community? 3°. How far may the average death-rate of a population be considered an efficient test of its sanitary condition, and by what means can the high death-rate of children be reduced?

— *Nature* states, that Dr. Chavanne, who is travelling on the Kongo for the Brussels national institute of geography, has established a meteorological observatory at Boma. Mr. Stanley has transferred the site of his station of Vivi to a tableland some fifteen hundred metres to the north; and a railway from the new station to the Kongo is in course of construction. A new station, called Sette-Cana, has also been established at the mouth of the small river Sette. Numerous small wooden houses are being made in Belgium to be transported to the new Vivi. A sanatorium has been constructed at Boma.

— In the report of the surgeon-general of the navy for 1881 (Washington, 1883, p. 70) are to be found photo-micrographs, and a short account of a comma-shaped bacterium, a rather unusual form, observed by Surgeon J. H. Kidder in water through which air had been aspirated (summer of 1881), and in well-water near Washington (1883). Until we have more precise descriptions of Koch's cholera bacillus than are yet available, it will be judicious for microscopists to bear in mind, in case of the appearance of cholera on this side of the Atlantic, that similar forms have been found in water when no case of cholera was known to exist. Dr. Kidder supposed the form which he photographed to be the same as, or very similar to, that noted and figured by Billroth (*Untersuch. über coccobacteria septica*, Berlin, 1874, taf. ii. *B.*, *C.*), found in the droppings from an imperfect water-faucet in his work-room, and called by him Siphonomyxa nostocomii viennlensis.

— The treasurer of the local committee of the American association reports that fifteen thousand dollars have been raised for the entertainment of the association while in Philadelphia, and recommends that the expenditures be kept within that sum, as it is doubtful whether more could be obtained.

— Dr. Benjamin Apthorp Gould, director of the observatory at Cordoba, Argentine Republic, has been elected an honorary member of the Royal meteorological society.

— An exhibition of appliances used in brewing will be held next September in Hanover.

— The *Kansas city review* states that Prof. J. G. Porter of the coast-survey has been elected astronomer of the Cincinnati observatory.

— By some good fortune whose explanation is too deeply political for our fathoming, the monthly Pilot charts continue to be issued from the hydrographic office; and the number for July maintains the value of its predecessors. It is notable for the number of waterspouts, of which eight are charted, and for the indication of currents by floating wrecks that have been observed on different dates. The schooner Warbeck drifted eastward just south of latitude 40°, from longitude 64° on April 9, to longitude 44° on June 12, thus travelling about nine hundred miles, or fourteen miles a day. A buoy, adrift from Cape Hatteras on June 1, was noticed on its way north-east on June 11, and was unfortunately picked up in latitude 40°, longitude 63° 30′, on June 21, having floated about five hundred miles in twenty days. These having followed the main extension of the Gulf Stream, their rate of motion was relatively rapid. The bark Ponema, that collided with the British steamer State of Florida on April 18, latitude 49°, longitude 36°, is reported from London to the hydrographic office as having been sighted on June 7, in latitude 49° 15′, longitude 33°, about thus having averaged only about two miles of eastward drifting a day. Again: the schooner Maggie M. Rivers, wrecked off Cape Hatteras on Jan. 7, was sighted on the eastern margin of the Gulf Stream on Feb. 6, and since then has been seen four times, the last date being June 14, wavering about with small change of position in the slack water a third way from the Bermudas to Norfolk.

SCIENCE.

FRIDAY, AUGUST 1, 1884.

COMMENT AND CRITICISM.

Vith all the applause bestowed on Lieut. eely and his comrades for their self-sacrifice l heroism, we hear continually the remark, hope this is the last of arctic explorations.' iis is not a strange utterance to proceed om those who have given no thought to the agnitude of the problems involved in modern olar research. One can even smile when a erson who has never considered the subject ys with spontaneous humanity, "Such expeitions may be very good for science, but they re very bad for men." But it is astounding o read the words which are attributed by the nterviewer to the president of the United tates when he heard of the rescue of the reely party. He is reported by the New-ork *Herald* (July 18) to have said that he 'had never favored these explorations, as the eographical and scientific information secured ould not compensate for the loss of human ife. He could not see what had been gained, o far, that would justify any men, however mbitious and daring, in making another attempt."

For the following reasons, we take a very lifferent view of such expeditions. The pubic need to be reminded, to begin with, that cience is not a person, a party, or a society, hat has 'interests' to promote. Science is ccurate knowledge, systematically arranged by nen for the good of men. To promote science s to promote an understanding of the world in which man dwells. Every great discovery in cience sooner or later proves to be for the good of man. A great philosopher once said, There is nothing so prolific in utilities as abstractions:' and, if this be true, the intimations hat discoveries may be 'good for science, and ad for mankind,' are based upon a fundamental error, which should always be met with a protest.

Again: there is a strong presumption when ten of the most enlightened governments in Christendom (England, France, Germany, Austria, Russia, Denmark, Sweden, Norway, Holland, and the United States) are persuaded by men of the greatest wisdom and knowledge, at the suggestion of one who knew by personal experience the hardships involved (the explorer Weyprecht), to engage simultaneously in a certain line of investigation — we say there is a strong presumption that the investigation thus proposed is of profound importance to the world. In this case the problem is one which every intelligent man can appreciate: it is nothing less than to increase our knowledge of the physics of the globe; to gather such facts, from so many places and by such careful methods, as will throw light upon the fundamental laws of terrestrial magnetism, and upon all the forces which govern the winds, the currents, and the ice-floes of the northern hemisphere. The chief result in view is not that which attracts the most applause; it is not the indication on our maps of a few more miles of land, nor the carrying of our flag to a point a little nearer the pole than any flag has ever been: it is the addition to science of observations made daily during a period of well-nigh two years, in a station most inaccessible, but most wisely chosen for comparison with a dozen other stations where like observations have been in progress.

This contribution to human knowledge may, as the decades roll on, and it becomes a part of the capital of the world, yield the most abundant fruits. It was obtained, it could only be obtained, by the bravery, the intelligence, the self-sacrifice, of heroic men, sustained by governmental aid, strengthened by the consciousness that other men were else-

where engaged on the same humane service. Greely and his associates took their lives in their hands for the good of humanity, as the soldier does when he enters the army, as the physician when he studies the scourge, as the missionary when he penetrates the dark continent, as the navigator when he enters unknown seas. Some of the number have fallen without reaping the rewards of their enterprise; some are returning with emaciated forms; all bravely did their part, and will be honored by their countrymen. 'Peace has its victories as well as war;' and those who have fought frost and famine, who have endured the hardships of three polar winters, that they might add to human knowledge, deserve the lasting gratitude of all thoughtful men. In days when luxury and comfort chain so many people to the fireside, and when the occasions for heroic action are so rare, it is good for human nature to witness fresh examples of heroism, all the better that these examples are for the sake of advancing science. All honor, therefore, to Greely and his brave companions, living and dead; and honor, too, to Schley and his crew for the rescue they effected with so much skill. Now that these men have reached the ports of their native land, there should be a better welcome for them than disparaging remarks, and the hope that there will be no more such efforts. 'Let knowledge grow from more to more,' and let those who extend its boundaries by hardships and bravery have their honorable places in the annals of science, and be welcomed without reserve when their arduous exploits are concluded.

As THE season approaches when our scientific men congregate for consultation upon matters of common interest, it may be well to call their attention to a small matter, which is really of more consequence than would at first appear; namely, to the practice of repaging authors' extra copies of articles published in journals and transactions of learned societies. The practice here complained of must occasionally be annoying to physicists, and, indeed, to every one who wishes to cite correctly, or to look up the references of previous writers; but it is severely felt by naturalists, who have so many names to cite or refer to, and to whom correct bibliography, and prompt and right reference, are essential. In the case of an actual reprint in an independent form, there may be good reason or necessity for repaging; yet even then the original pagination should be indicated. But in printing extra copies from the original type, there is no such necessity, and no real advantage: on the contrary, much disadvantage and confusion arises when a paper is cited from the journal or transactions of a society to which it was contributed, but under wrong pages. Some societies and journals refuse to have the original pagination removed; and, in our opinion, all should do so. Separate paging in addition may be permitted; but it were better to dispense even with this.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Light in the deep sea.

PROFESSOR Verrill's article in *Science*, No. 74, suggests the inquiry whether the faint light that he supposes to penetrate the deep seas may not have some rays of nearly all colors, and appear greenish to the deep-sea dwellers merely from an excess of rays of more rapid vibration, just as the sky appears blue from an excess of blue rays, not from the absence of other colors; and, further, whether the light reflected from the bright red or orange-colored animals that have been dredged from great depths does not give a many-colored spectrum, as is often the case with colored objects, so that, even when illuminated by greenish light, such animals would not necessarily be dull or black or invisible, but might be distinctly colored. If these questions were answered affirmatively, the explanation of the colors of deep-sea creatures by the operation of protective imitation would not be simple.

W. M. DAVIS.

Cambridge, July 12.

The long-continued 'bad seeing.'

'A fellow of the Royal astronomical society,' in the *English mechanic and world of science*, vol. xxxix. p. 345, writes, —

" . . . As to the bad definition incident on the visibility of the afterglow, I should like to remark, that, for some time past, *daylight* definition of celestial objects has been worse than ever I remember it during my tolerably long observing experience. Transit-taking in daylight, save with the larger stars, has been quite impracticable, and over and over again I have looked in vain for Mercury. Of course, every one who is in the habit of using a telescope in the daytime is familiar with the fact, that on many seemingly cloudless days there is an otherwise invisible kind of haze, which impairs or destroys definition, and that the best or brightest vision is obtained in the blue sky visible between large, floating annuli; but this curious obscuration has

as apparent during the latter condition of the atmos- during the former. Hasn't the Krakatoa dust all set- yet?"

er observer (p. 322) bears witness to this ed and oftentimes peculiarly bad definition;' W. S. Franks, in writing to the same journal attributes it 'to the unusually dry season.' those who are working upon the subject Krakatoa dust' can give some explanation exasperatingly persistent *bad seeing.* For past it has been noticed here by all who have sion to observe in the daytime, and, indeed, d it myself in the autumn of 1883; but I was ticularly struck with it at the time, as at seasons of the year we are in the habit of ex- a smoky atmosphere and poor definition, on of forest-fires or other causes. As the bad as continued even down to the present date, ot account for it in this way.

aziness is usually confined to the south of th (I am speaking more especially of meridian ions), and is most marked in the neighbor- the sun. The sky is white, though this ss is sometimes barely perceptible, and the e unsteady. Stars of the third or fourth de, which have frequently been seen on a erving day in other years, it is almost useless r now. That the phenomenon is not local vident from the remarks of the English ob- quoted above; but has it been noticed by a widely different latitudes?

WILLIAM C. WINLOCK.

on, D.C., July 22.

EAL UNIVERSITY FROM AN ENG- LISH POINT OF VIEW.

rticle in a recent number of the *Contem- review*, by James Bryce, on 'An ideal ity,' is well deserving the attention of ans, all the more because its author is glishman, writing with immediate refer- the wants of the city of London. He wever, by repeated visits to this coun- come familiar with what we are doing, possesses that truly philosophic mind is quite as ready to gather suggestions he experiments of a new state of soci- from old-world experience. An active r of Parliament, a professor of Roman the university of Oxford, the writer of orical work of remarkable power, accus- in his wide range of travels to observe scrimination the influences of different s, laws, and educational systems upon of the people, he combines in an onal way the wisdom of a scholar with the man of affairs. His plea is for an ation in the city of London which shall be a true university, not a corporation hold- ing examinations and conferring degrees, like the actual university of London, not a fellow- ship of colleges, not a group of museums and libraries; for all these are in existence. His plea is for something different from, if not higher and better than, any or all these agen- cies: it is a plea for that higher and better organization which thoughtful Americans in all parts of this country are trying to develop.

'What is an ideal university?' asks Mr. Bryce. The answer which he gives has in it nothing of novelty, nothing of eccentricity, nothing beyond the reach of a wealthy com- munity. It is the answer of common sense, directed by experience, to the solution of a very important problem. It is the answer which has often been given before, but rarely in such persuasive and intelligible phraseology. Assuming that a university is a body of men engaged in teaching the highest knowledge, and is therefore something very different from Carlyle's 'true university, a collection of books,' he claims that breadth is the first essen- tial,—catholicity, universality. He would have it include not only the subjects which are traditional (languages, mathematics, and the- ology), but the social sciences (politics and comparative jurisprudence), the sciences of observation and experiment, and even the applied sciences. In this last suggestion he is broader than most Germans, for they have hitherto inclined to teach the applied sciences away from the universities, in poly- technic and *real* schools. Americans have often, though not always, inclined to follow this German precedent; and those who hold the opposite view will be fortified in it by this word of Mr. Bryce.

The next essential of the ideal university is freedom. The writer plants himself firmly, and without reservations, on the doctrine that any one who comes may study any subject he pleases, whether or no he studies any other subject, or enters for a regular course. He would let the university prescribe its course or courses, and give its honors and degrees in accordance with such restrictions. "Place

guard, if you like," he says, "at the doors of your examinations; but let your lecture-rooms stand always open, like the churches of Catholic Europe, so that thereby even the passing wayfarer may hear the voice and be drawn in." With the main intent of this remark, most of our colleges agree, opening their halls to special students; but it may be as well to make a note of caution on the margin of what we read, lest the impression should be given that 'happening in' to an occasional lecture makes the scholar. The regular and persistent attention to a serious subject is the first element of success in university-work. The group of occasional attendants or special students in our colleges, according to our experience, includes a few of the very best, and some of the very worst, who ever enter the academic walls.

The third essential of the ideal university, according to Mr. Bryce, is that it should teach. This pointed remark is obviously directed to the idea, which has been more developed in England than anywhere else, that the chief function of the university is to examine students, and confer degrees. This is the avowed end of the university of London and of the Royal university in Ireland. In years gone by, even the universities of Oxford and Cambridge left the principal work of instruction to the colleges, reserving the prerogatives of holding examination and bestowing degrees.

These three elements — breadth, freedom, and teaching-force — are the essentials of a university. Supplementary powers are the bestowal of honors (if it is thought worth while to maintain the system of academic rewards), the prosecution of research (which will take care of itself, if teachers of real ability are secured), and, finally, the acquisition of endowments (on which Mr. Bryce lays but little stress).

On the subject of endowments, Mr. Bryce writes like one who has seen the evil which comes from the long perpetuity of individual whims; and he boldly declares that the principle should once for all be laid down, that charitable endowments belong, not to the dead, but to the living, and that each generation shall be free to use them for such objects as it finds most presently beneficial. These considerations ought to be weighed and discussed in the United States, where every year new and generous endowments are made for charity and education. One enlightened giver, whose name we could mention, having had his attention called to this point, expressly provided that the million which he gave, might, after a certain period, be applied by his trustees to a purpose akin to the original object, but not identical with it, if in their judgment such a course would be wise. The difficulties experienced at Andover and at Exeter in the management of the Phillips funds are examples of the celerity with which conditions become fetters.

Bryce's main doctrine is, that the ideal university must 'give first-rate teaching.' This, undoubtedly, is the true doctrine. But how are first-rate teachers to be developed or discovered, and how are they to be kept 'first-rate' under all the counteracting influences to which they are exposed? There's the rub. On these points we should like to hear further from Mr. Bryce. Shall only men of genius be chosen professors? There are not men of genius enough to go round. Shall practical instructors, those who are well versed in didactic methods, be preferred? The faculty which is filled up with such men will be governed by routine; it will have neither *éclat* nor inspiration: it will be like a military school, — a place for training, not a place for the development of great minds. But suppose first-rate teachers are secured, men who have some genius and some common sense, how are they to be kept 'first-rate'? We reply, The university is responsible for its treatment of its professors. They must be kept at work, in actual instruction, or they will grow indolent and sterile; they must have considerable leisure, or they will not think and write and investigate, but will simply be repeaters of old stories; they must have ample supplies of books, journals, instruments, for these are the diet on which they grow; they must have stimulants, the best of all being the attention of bright and

growing scholars around them, the next being a consciousness that they are responsible for what they do to the world of science and letters, and not merely to their own colleagues and followers; and, finally, they must not only be fairly paid, but must be protected from temptations to every form of extravagance in the employment of their resources. Such are some of the difficulties which are to be encountered when the simple idea of 'first-rate teaching' is expanded.

All that Mr. Bryce says about the end of an education is excellent: "It is not to train students merely as lawyers, physicians, clergymen, engineers, bankers, merchants, and statesmen, but as men; and the best thing the university can do for them is to form in them what we will call the philosophic mind."

THUNDER-STORMS.

BENJAMIN FRANKLIN once remarked, in substance, sadly to a friend, "It is now eight years since I showed that mankind could be protected from the danger of lightning by lightning-rods; yet there is hardly a house in Philadelphia provided with them." The heart of the great American philosopher would be greatly warmed if he could perceive the activity of his disciples, who waylay every builder of a house, and awaken fears where all was peace before. There is no question oftener asked of the professor of physics than this: "Shall I put lightning-rods on my house, and, if I erect them, what should be their form and position?" Personally I have given the following abbreviated answers. "If your house is surrounded by tall trees, or if there are higher houses in your immediate neighborhood, I should trust to the trees, or kindly leave the expense of the lightning-rods to your neighbor. If your house stands alone, a prominent point in the landscape, on a cliff, or remote from trees, I should be in favor of a properly placed lightning-rod. I should place two or three pointed rods three or four feet above the highest point of the house; allow the metallic rod, which should be at least one-half a square inch in section, to rest, without glass insulators, upon the house; connect all the tin sheathing, the copper gutters, the gas and water pipes, with this lightning-rod; and conduct the latter, by the shortest course possible, to *wet earth*."

These answers seldom conclude the correspondence, however, although one generally prefers to leave to the neighbor the expense of erecting lightning-rods. One brings instances of houses having been struck which are situated lower than one's neighbors, and are surrounded with tall trees which over-topped the houses; and one asks with a shudder, "Can I connect my gas-pipes with a lightning-rod?" Indeed, the writer or would-be authority on lightning-rods has not an easy life before him. He must not only satisfy the timid heart of the believer in him, but he must also fight with all his knowledge the brazen limb of ignorance and superstition, who starts with the postulate that no scientific man knows any thing concerning thunder and lightning, and that the true knowledge has been revealed only to himself while working in a cornfield. It is not long since, that an American professor of physics was sued for twenty or thirty thousand dollars damages for maintaining that the members of a lightning-rod company which placed lightning-rods like a letter U upon the roofs of houses were practically quacks; the theory of this lightning-rod being, that the lightning, if it struck one point of the U, would be dissipated into the air from the other point. There is a lightning-rod company in Massachusetts at the present time which erects lightning-rods on the theory that lightning always seeks electrical earth-currents; and, if there are earth-currents beneath a house, that house should be protected, and the rods led into the path of the earth-current. If, on the other hand, no earth-currents run near the house, such a house is safe, and needs no lightning-rods. The electrician of this firm is self-taught: there are no books on electricity in his library. He discovers the earth-currents by a forked stick. Not deterred by the fact that there is no evidence to prove that a discharge takes place between a charged cloud and a current of electricity in the ground, and, moreover, no evidence to prove that earth-currents move in regular paths through the earth, and, indeed, no *conclusive* evidence of the existence of earth-currents, he persuades even the so-called practical electrician to rearrange the lightning-rods on his house.

The student of electricity is therefore called upon to assert the grounds of his belief: and he finds it difficult to convince his audience; for they are, in general, not sufficiently conversant with electrical phenomena to appreciate his arguments. The position taken by most professors of physics on the subject of lightning-rods is based upon the experiments of Franklin, in which he showed that pointed metallic rods,

so to speak, facilitated electrical discharges; the experiment of Faraday, by which it was shown that a person, and even the most delicate electrical instruments, inside a large metallic cage which was connected with the ground, were unaffected by powerful discharges of electricity between the cage and the prime conductor of an electrical machine; and the statistics collected by the English government, which show, that, since vessels have been provided with lightning-rods, the number of casualties produced at sea from lightning have been greatly reduced. A building covered by a metallic netting suitably connected with the ground would be well protected from lightning. The nearest approach to this condition of safety would be to connect all the network of metallic conductors about a house with wet ground; and one argument against placing under ground the network of telephone and telegraph wires in cities is, that at present, where they are very numerous, they protect buildings from danger from lightning. This is, of course, not the case where a single telephone or telegraph wire enters a house. The latter should always be well connected with the gas or water pipe. In regard, however, to the belief that tall trees, higher than the houses in their immediate neighborhood, protect the houses, we can point to the well-known efficiency of small points in facilitating electrical discharges by slow degrees. Each leaf and twig is such a small point. Moreover, during a rain, the dripping from the leaves reduces the electrical charge on the tree to the same sign and amount as that of the air in the immediate neighborhood, as is shown by the well-known experiment of Sir William Thomson, in which an insulated can, from which a stream of water issues in drops, is connected with an electrometer; and the latter shows that the metallic can has taken the charge of the air in its neighborhood. The drops of water continually reduce the can to the electrical potential of the neighboring air. The tree, therefore, can be looked upon as a more important electrical factor than the few salient lower points of a building.

It is safe to affirm that not one out of a thousand lightning-rods at present upon our buildings are of any use, for the simple reason that they are not led into moist ground, and therefore offer great resistance to the passage of an electrical discharge. Any one can be convinced of this by scraping the lightning-rod at any point, connecting a bright wire at this point, and, having led the other end of the wire to the water-pipe or to a body of water, placing one or two Leclanché cells in this circuit, and leading the wire in a north and south direction directly over an ordinary pocket-compass. If the lightning-rod enters moist ground, or makes a connection with the earth, the compass should indicate an electrical current by its deflection. Generally it will be found that no such earth-connection exists, and the lightning-rod is therefore worse than useless. It should be immediately connected with the water-pipe, or with a spring, or some body of water. To illustrate the fact that the mere entrance of a metallic rod into the ground is not enough to insure the passage of an electrical discharge to the ground, drive two metallic rods into your lawn, at any suitable distance apart; connect them by a wire, which includes a Leclanché or other voltaic cell; and, having led the wire over a pocket-compass in a north and south direction, see if you obtain a deflection of the needle. If, moreover, you labor under the delusion that a surface-sprinkling of the earth near the rods will give an electrical connection, it is best to perform the experiment. It is probable that several acres of lawn would have to be thoroughly sprinkled before a suitable earth-connection could be obtained. A few experiments with a modern electrical machine — a Toepler-Holtz machine, for instance — will readily convince one of the effect of points in dissipating an electrical charge, and of the fact that an electrical discharge always takes the path of least electrical resistance between two points. Having ascertained these facts, one has acquired all the intellectual capital that is possessed by most lightning-rod men. If one apparently discovers that gilded lightning-conductors, or twisted ones, have peculiar attractions for the electrical discharges, one leaves the sure ground of fact for the region of the unproven. The difficulty in our study of thunder-storms is, that we cannot experiment on a sufficiently large scale, and our means are too tardy to allow us to follow the exceedingly rapid changes of electrified bodies. What we call freaks of lightning are merely the expressions of electrical laws, combined with the laws of elasticity of matter. The forked lightning-discharge is an expression of the fact that a positive charge is combining with a negative charge along a path of least resistance; and the air is fractured, so to speak, by the compression, just as a plate of glass yields in zigzag cracks when it is supported on one edge, and a force of compression is applied to the other edge. The influence of the medium through which the electrical discharge takes place can be readily

seen by obtaining the electrical discharge in different gases, such as carbonic-acid gas or nitrogen, and comparing these photographs with those taken in free air. Although we can study certain phenomena of atmospheric electricity successfully in our laboratories, yet we cannot charge a cloud with positive electricity, and fill the sky with different strata of hot and cold air. It is generally believed to-day among scientific men, that the electricity of thunder-storms cannot be attributed to sudden evaporation or condensation of moisture; for direct experiment has failed to reveal any electricity which is due to these causes. Mr. Freeman made many delicate experiments in the physical laboratory of Johns Hopkins university to decide the question whether evaporation produces electricity, and he could find no evidence of any that was due to this cause. Herr Kayser has also lately experimented at the physical laboratory of Berlin upon the electrical effects of condensation, with negative results. Personally I feel that all the experiments hitherto conducted on the electricity due to evaporation and to condensation have been conducted on too small a scale to test the question; and I do not see how they can be conducted on a larger scale. When we think of the immense plan upon which these operations are conducted in nature, of the evaporation from every square foot of the ocean, and of the rapid condensation through miles of space, we can realize that an infinitesimal amount of electrical charge, too small to be detected in a laboratory, might be integrated into a large amount, and, becoming localized, might produce the tremendous electrical disturbances which we witness in thunder-storms.

How, then, can we conduct future investigations upon thunder-storms? The most promising direction for scientific work seems to be in the establishment of systematic observations on thunder-storms, and on atmospheric electricity in general, over a large tract of country. In certain regions, thunder-storms follow certain definite paths, and other tracts are never visited by them. There is a general impression that electrical storms are, in common language, attracted by rivers, and are more severe about large bodies of water in general. However this may be, nothing but systematic daily simultaneous observation, long continued, can increase our knowledge. If the government, in connection with the signal-service, should establish a number of electrical stations throughout the west and south, where thunder-storms and tornadoes are so frequent, daily thunder-storm maps might be issued, showing the probable path of the electrical disturbances. Perhaps we should then see, in districts peculiarly infested by thunder-storms, certain 'insurance-against-danger-by-lightning retreats,' in which Benjamin Franklin's lightning-rod should rise from a small hut, completely covered with a network of metallic rods which are connected with running water or a large extent of moist earth. These safe retreats would certainly be a great desideratum for many who now suffer greatly from nervous terrors during thunder-storms.

John Trowbridge.

THE FORMATION OF CAÑONS AND PRECIPICES.

One of the most remarkable natural objects in the state of New York is to be seen at the crossing of the Genesee River, at Portage station, on the New-York, Lake Erie, and western railroad, 362 miles from New-York City, and 83 from Buffalo. The railway here spans a deep gulf on an iron bridge 820 feet long and 235 feet high, near the upper end of a wonderful cañon. There are three falls of the river immediately below the bridge, measuring 60, 90, and 110 feet respectively. The gorge runs out in the Genesee shales at Mount Morris, being 20 miles long by the meanderings of the river, which falls 500 feet in that distance. In some places the banks are 350 feet high, nearly perpendicular, and the ravine is wholly impassable. It is a fine example of the work of water; and there are hundreds of others in that state, on a smaller scale, in the upper part of the Portage group. One of these is the celebrated Watkins Glen, a beautiful cañon two miles long, with a succession of cascades. The neighboring glen at Havana is very similar; and there are a number of others farther north, several of which may be seen at Big Stream, Rock Stream, Dresden, and other places. Taghanic and Lodi Falls, and the glens and ravines about Ithaca on Cayuga Lake, and many other similar places, are all on the Portage formation, which forms a narrow east and west band across western New York. It might be added, that both Seneca and Cayuga Lakes are, in part at least, simply old Portage glens, now filled with water. To many reflecting persons who, as summer tourists, visit these very curious and beautiful resorts, the thought occurs, why these cañons are in these particular places above all others, and how they have been caused, the work of glaciers, or some convulsion of nature, being

the common explanation; and amateur geologists puzzle themselves about their origin. It looks as though there was something special about the Portage group of rocks, everywhere abounding, as it does, in glens, gorges, and cañons, to which the formation of these remarkable places is due. Why is the Portage, of all the ten or twelve formations in this state, the favorite one for these phenomena, being composed, as it is, of sandstones and shales very similar to those in other localities where nothing of the kind is found?

The explanation is simple enough; namely, that it is owing to the peculiar alternation of thin beds of soft shale and harder sandstone rocks, and the presence of a stream of water running into lower ground, which performs the work of erosion, and the size of which must be adapted to the work; and upon that, too, the size of the gulf depends. Beginning at the lower end or mouth of the present cañon, the action of the waterfall first removes a little of the softer layers of shale, leaving the thin beds of harder sandstone projecting for a time, which, in their turn, are also broken off from want of support, in masses small enough to be entirely carried away by the stream, especially during the winter floods; thus preventing the formation of a slope, and exposing the bottom of the falls to another erosion. Thus, by the recession of the falls, the cañon is formed, provided another requisite is afforded; namely, that the side-walls must maintain their erect position: otherwise a valley, instead of a cañon, is formed.

This raises another question; namely, why do not these precipitous side-walls, composed of apparently soft rocks, slope themselves down, and form well-rounded hills, as they do elsewhere? The answer is, because the harder layers of sandstone form what a mason would call ‘the binders,’ which hold the natural wall in its upright position. The erosion of the cañon is done by the stream of water undercutting, like the work of the coal-miner, and then breaking down, the unsupported ‘top-bench;’ while, in the mean time, the action of the air and frost on the side-walls is so much slower than that of the stream of water, that, while the latter is rapidly cutting back, and making the ravine longer and deeper, the sides remain in their original upright position. As the falls recede, and a thicker sandstone or shale rock occurs, without the proper alternation of strata, it will form the permanent upper end of the gulf, which will be a precipice if it is a sandstone, and a slope if it is a thick bed of shale. It thus happens that the Portage portion of nature's masonry, and the necessary streams of water passing over it, are nicely adapted to the formation of glens and cañons. In localities where there are no streams of sufficient size passing over the Portage group to a lower level, as on the summit levels, there are high hills, it is true, but no glens or gorges. The eroding action of the elements being more uniform over the whole surface, and the transporting power of a rapid stream to carry away the falling fragments being wanting, therefore slopes, instead of precipices, are there produced.

There are also, in the state of New York, limestone glens, as they might be called, which are due to the same cause. At Trenton Falls, on the Utica and Black-River railroad, eighteen miles north of Utica, East-Canada Creek has cut a narrow passage, three miles in length, through the Trenton limestone, the formation being named from this locality. It is a cañon with vertical walls a hundred feet high, in which are the celebrated and very beautiful falls. The cause of the erosion is, that the limestone rock is in thin layers, of from six to ten inches thick, separated quite regularly by thin layers of shale of about the same thickness. It is owing to this regular mixture of hard and soft rock, in alternate courses, that the stream has been able to wear away the rock by undermining the shale into a succession of cascades; and, what is equally important in forming a cañon, the stream, a wild torrent from the Adirondack forests, is large enough to carry away the fragments of the overlying limestone as fast as it gives way. After cutting its channel back to a village called Prospect, a thicker and harder layer of gray limestone is encountered, which has stopped the recession of the falls, the stream being unequal to its destruction; and that is the end of the ravine.

The gulf of the Genesee River from Rochester to Lake Ontario was caused in the same way: for although the rocks are much thicker and stronger than any of those above referred to, yet the river is a correspondingly larger stream, and was able to cut through the alternating beds of Medina, Clinton, and Niagara limestone, shale, and sandstone; and the flood of water is powerful enough, with the aid of the fall below, to carry away the material, and prevent the formation of a talus.

At Niagara Falls and the gorge below, in the same formations as at Rochester, is a repetition of the same operation on a vast scale; and as the river there is larger than the Genesee, so the cañon is also longer, deeper,

nore thoroughly cut down, the river's ng and transporting power being in pro-n to the great beds of shale, sandstone, imestone.

many localities in the state of New York lsewhere, there are glens and ravines cut y out of the Genesee and Hudson River s, where there are no alternations of hard oft strata, as in the Portage. Precipitous les are also of frequent occurrence, al-h the face of the rock soon turns to soil. eason why the edge of apparently so soft k of such fine material withstands the er, and presents these naked sections for a length of time in mural banks in ravines, courses, and upon the shores of lakes, is count of its uniformly foliated structure. y slight examination will serve to show hin laminae of which the entire rock is osed, like sheets of paper, reminding one e resisting power of the edge of a book. hardness of some kinds of coal is also g to its laminated formation. A precipi-wall, whether built by nature or by art, either be laid with a good cement, or ist be composed of material having a bed, 'breaking joints' both inward and lly.

peculiarity of the loess or bluff formation e Mississippi and Missouri Rivers is, although it is very fine, soft, and easily rated with the spade alone, yet it presents steep slopes and precipices resembling of solid rocks. Unlike all other forma-of an earthy nature, it remains unchanged e atmosphere and the action of frost. -cuts and embankments, however steep, for years like a wall; and wells dug in it re to be walled only to a point above ater-line, while the remainder stands so ely without support, that the spade-marks n upon it for years, although it is not cemented together. In the city of St. h, and all other places where the bluff tion is found, these peculiarities can be seen; and they appear very remarkable eastern man, accustomed to the sloping of banks of sand and clay. The ex-tion of it is, that, as is well known, the is a lacustrine deposit. The material ng it floated in flakes in a quiet, shallow The minute particles, assuming a flat-form, however it may have been caused, very quietly and gently deposited in lay-ke little sheets of paper. There was no t, no movement of the particles to form ed grains of sand, irregularly deposited idental disorder. On the contrary, the bluff is a well-built piece of miniature natural earth masonry, well bound together: hence there is no rolling tendency in the material, and, when cut down at right angles to the layers, it does not form a slope, like other kinds of earth. Thus, from precipices of rock of the heavier strata to those composed of the smallest, their mechanical structure is of great importance, and the same homely comparison of the 'stretchers and binders' of an artificial wall applies.

JAMES MACFARLANE.

Towanda, Penn.

THE EQUATORIAL COUDÉ.

IN spite of the loss of light in the two reflections from its mirrors, — which loss will vary with the condition of the reflecting silver films, but, under the best conditions, should not much exceed twenty per cent, — the equatorial coudé of the Paris observatory would seem to be the coming form for nine-tenths of the equatorial work of an observatory. This form of 'elbow equatorial' has been described of late in so many scientific periodicals, that it is sufficient here to say that the polar axis forms a part of the tube, at the upper end of which the observer sits like a microscopist at his desk, and at whose lower end a 45° mirror turns the course of the rays into a tube at right angles to the axis; and at the outer end of this tube is the objective, with still another 45° mirror outside of it, which turns round the axis of this tube. This gives the motion in declination, and the rotation of the whole round the polar axis gives the motion in right ascension. All the movements, the reading of all the circles, the illumination, and every thing connected with the management and use of the telescope, are directly under the observer's control as he sits at his desk, where there is every facility for attaching spectroscopic, photometric, and micrometric apparatus to the eye-piece end, which keeps its fixed position. Moreover, the observer and all this accessory apparatus can be entirely roofed in, and the room warmed in cold weather, if desired, and the observer made as comfortable, and the work as convenient, as that in any laboratory, while the whole heavens are at his command.

There can be no question as to the desirability of this, when compared with the discomfort and exposure in the common observatory dome, and with the difficulty of attaching accessory apparatus to, counterpoising, and using it upon, the moving end of an ordinary equatorial. Still further, the observing-room can be made entirely dark when desired; and the increased sensitiveness of the retina, under these circumstances, will be a great gain in delicate spectroscopic and photometric work. Also, in work upon the sun, the possibility of protecting the accessory apparatus entirely from the sun's direct rays, and even of working in the dark if desired, will be a great improvement upon the inconveniences unavoidable in the common observatory dome.

The important point is, whether equally good definition can be attained with these two extra reflections. Experience alone can decide this with certainty; but up to the limit already tried in the Paris instrument, about ten inches aperture, we have the strongest evidence of its possibility. Dr. Gill, astronomer at the Cape of Good Hope, in describing to the Royal astronomical society a flying visit to continental observatories, speaks of the Paris equatorial coudé as follows:—

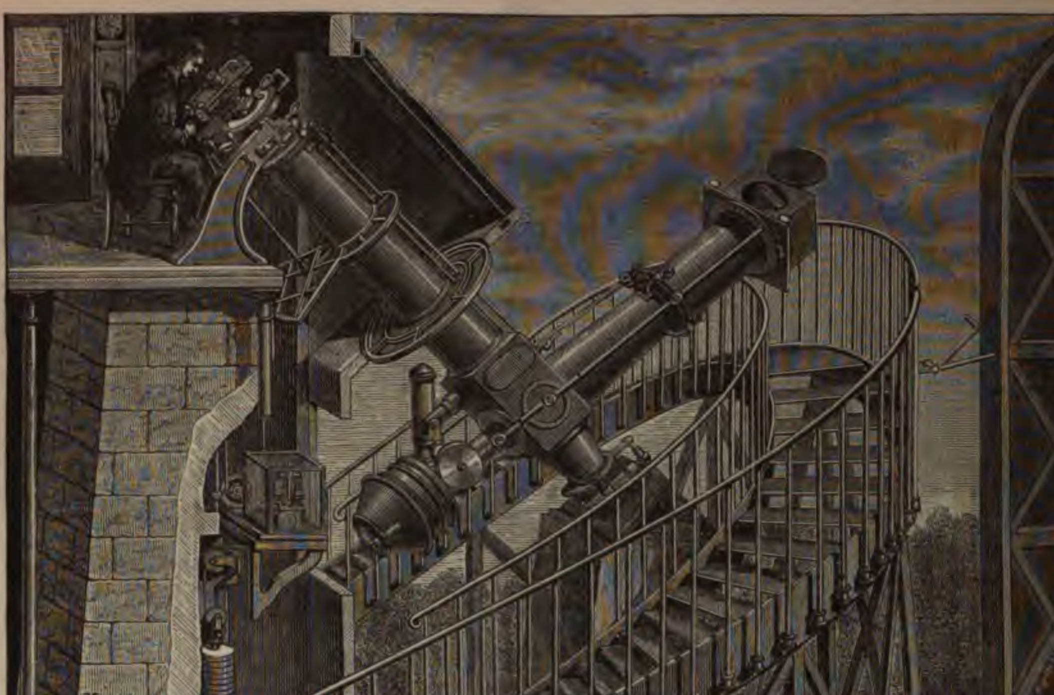
"One fine night, about eleven o'clock, we went to the observatory, and set on γ Leonis; and I am bound to say I never saw the diffraction-disks of a star better defined than in that instrument. They were perfectly circular. The disks came as sharply to focus as any I ever saw; and I would not have believed, if I had not seen it, that it was possible to make an instrument in which, after two reflections, such definition could be found. I am bound to say I never saw better definition in any instrument, and I never measured a double star so pleasantly and easily before."

Dr. Gill's well-known investigations in stellar astronomy give to whatever he says in this line great weight, and no stronger testimony could be desired.

When it comes to the question of the largest apertures, it would seem, *a priori*, that there should be no difficulty in making a glass mirror — where the internal constitution of the glass is not in question, and only one plane surface is demanded — 1.41 times as large as an objective, in which the glass of the two lenses must be homogeneous throughout, and four perfect surfaces are required.

Also it would seem, that if large lenses, whose thickness is limited, can be supported at the rim so that the distortions due to gravity are not appreciable in the definition, then mirrors whose thickness is unlimited, and which can be supported in every possible way at the rim, and all over the back surface, might be made sufficiently rigid to resist distortion. To be sure, the effects of distortion are of quite a different order in the two cases, the effect of gravity in increasing the curvature of one side of a lens being partly counteracted by the diminished curvature of the other side, while the distortion of a single reflecting surface appears with its full effect in the definition. But the far greater facilities for making the mirrors rigid should make up for this in a large degree. At any rate, the French opticians seem to have full confidence in their ability to do this, and it is certainly to be hoped that they will succeed.

Washington. H. M. PAUL.



EQUATORIAL COUDÉ AT THE PARIS OBSERVATORY. (Reproduced from *l'Astronomie*.)

THE ECHINODERMS DREDGED BY THE TALISMAN.[1]

AMONG the deep-sea echinoderms, some of the holothurians attain a large size, one being seventy centimetres long. The mouth is situated at one end of the body, although near the termination of the

[1] Abridged from the French of H. FILHOL in *La Nature*.

intestines, which open at the other end of the creature, are the orifices of branching tubes forming the respiratory organs. When holothurians are disturbed (as on being caught, for instance), they contract, and suddenly shoot out their viscera. But what is more singular and inexplicable is, that after some time these organs are reproduced. It would seem that the life of these animals, at whatever depth, would pass in perfect quiet; yet the holothurians living near the surface, as well as those between four and five thousand metres, are harassed by a swarm of parasites. Thus some of them, as Van Beneden says, are transformed into a kind of living hotel; some lodge in their respiratory organs little fishes (Ferasfer) with a body as long as that of an eel, but contracted; others shelter one or more couples of the little crabs called Pinnotheres, or carry in their intestines the worms called Anoplodium. But besides these parasites, which do not live at the expense of the host, of whom they demand only a home, there are others which live on the host.

Perrier says, "A holothurian has essentially the form of a five-sided melon with an opening at each extremity. With holothurians of great depths, however, this form almost entirely disappears. Some curve themselves back into a U-shape; others, as Ankyroderma, have the form of an ovoid sac, without the ambulacra which cut the surface of the other holothurians into five arms; the majority, instead of the characteristic radial symmetry of their allies, present a bilateral symmetry as distinct as that of the worms and the vertebrates, and creep on the mire by means of a ventral sole, like slugs, forming a peculiar example of the mode in which two organic types which seem separated by an unbridgable abyss may be found in the same animal."

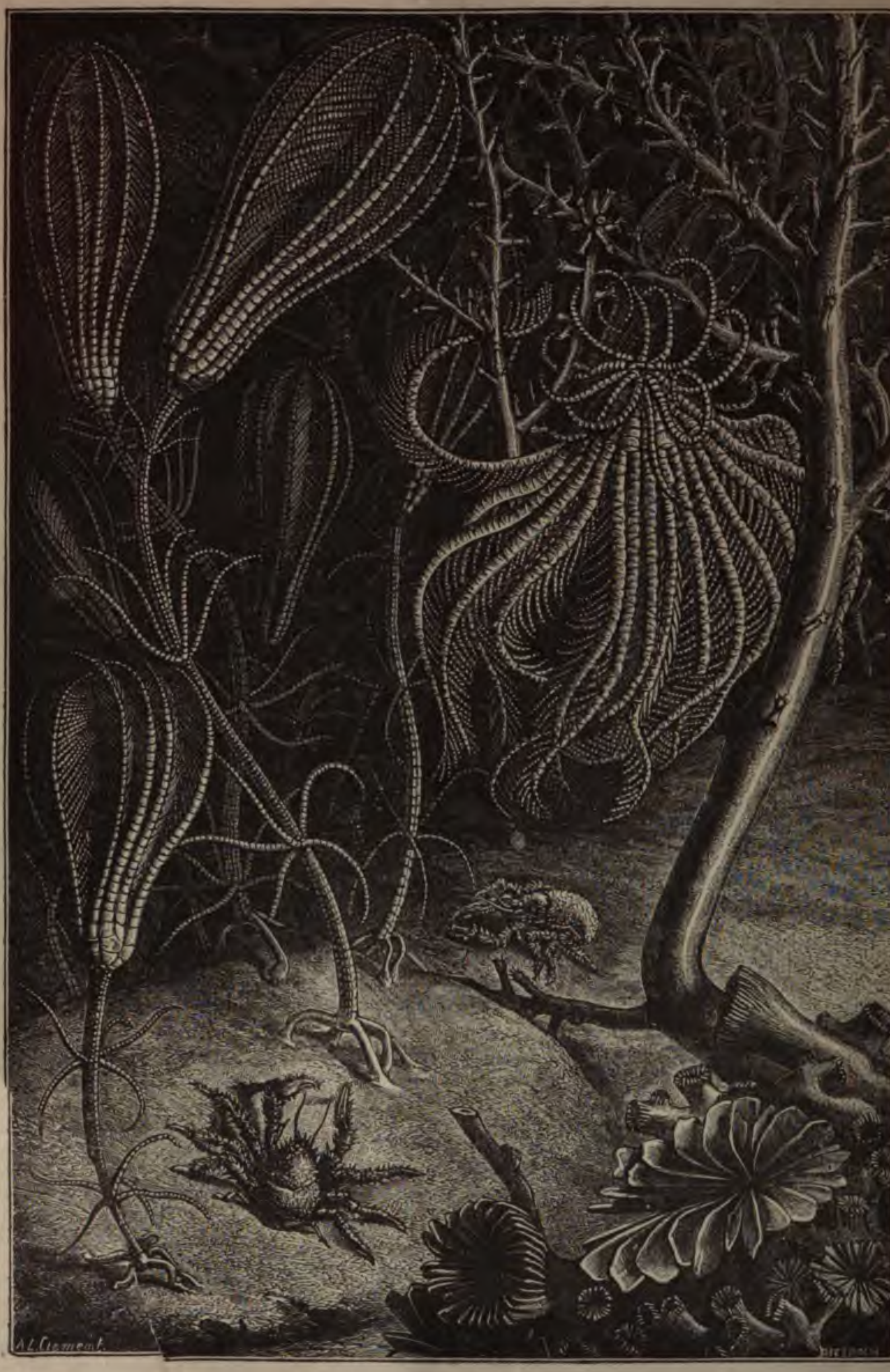
The sea-urchins are represented at great depths by forms very varied, and peculiar to certain zones. Some are remarkable for the development and beauty of their spines. For a very long time the remains of a genus of echinoderms called Calveria had been found in cretaceous deposits; but only in 1869, during the cruise of the Porcupine, was the survival of this form at the bottom of our seas revealed to us. "As the dredge was coming in," says Thomson, speaking of this form, "we got a glimpse from time to time of a large scarlet urchin in the bag. We thought it was one of the highly coloured forms of Echinus Flemingii of unusual size; and as it was blowing fresh, and there was some little difficulty in getting the dredge capsized, we gave little heed to what seemed to be an inevitable necessity, — that it should be crushed to pieces. We were somewhat surprised, therefore, when it rolled out of the bag uninjured; and our surprise increased, and was certainly in my case mingled with a certain amount of nervousness, when it settled down quietly in the form of a ... and began to pant, — a line of ... the least of it, very unusual in ... order. Yet there it was, ... of a sea-urchin, its ... interambulacral areas with ... and fine, sharp, blu...

dulations were passing through its perfectly flexible leather-like test. I had to summon up some resolution before taking the weird little monster in my hand."

The flexibility of the sides of this particular echinus, as was discovered, is due to a peculiar arrangement of the pieces forming the test. As for the palpitation which seems to have so impressed the English naturalists, it is simply due to the ship's rolling or pitching, or else to the vibrations arising from the action of the engines on board.

A group most abundant in new forms is composed of the beautifully formed and often brilliantly colored animals called star-fishes. Attention must be directed first to Brisinga, which sometimes has as many as twenty long, flexible arms. These brilliant orange-red stars often violently detach their arms when they feel themselves caught and drawn up by the movement of the trawl; and it is very rarely that they can be studied in an uninjured state. Absjornsen, who first discovered them on the coast of Norway a little above Bergen, at a depth of 200 fathoms, much admired the phosphorescent light shed by the body and the arms. "Whole and uninjured as I saw it once or twice under the water in the dredge, this animal is peculiarly brilliant, a veritable *gloria maris;*" and he accordingly gave it the name Brisinga, from a jewel of the goddess Freya. Brisinga coronata was obtained at the tropics, hitherto found only in the German ocean. In the cruise of the Porcupine it was found at 914 metres. We found it between 736 and 1,435 metres. Other species occur at depths ranging from 882 to 3,455 metres. All these forms are new, and so abundant that thousands cover the bottom of the sea.

Crinoids, the last echinoderms of which we shall speak, are cup-shaped. From the edges extend simple arms, bifurcated or branched, with pinnules at the sides. From the back grows a jointed rod, which attaches itself to surrounding objects. In Antedon and Actinometra, represented on the plate, this rod exists only during an early stage, the body becoming free at a certain point in their development; while with Pentacrinus, also figured, and with Democrinus and Bathycrinus, it continues during the life of the animal. The crinoids have always been considered by naturalists interesting objects of study, as much on account of their rarity in the present marine fauna, as on account of their great abundance in old geologic periods. In fact, these animals were common during the Silurian period ... in numbers at the time of the calcare... erous deposits, which are formed alm... of beds composed of their remains. ... bundance in that middl... posits called muschelkalk ... dinary prosperity, cri... says, to have gotton the ... existence. As they ap... he species become rarer, ... individuals. At one tim... alone existed at the p... s made in the deep-se...



BOTTOM OF THE OCEAN AT A DEPTH OF 1,500 METRES, PEOPLED WITH PENTACRINUS, AND SHOWING ALSO SOME COELENTERATES (MOPSEA AND OTHERS) AND CRUSTACEANS.

in the abandonment of this idea. Certain forms of crinoids, as Pentacrinus, Democrinus, and Bathycrinus, are peculiar to great depths, and form in our seas numerous and widely separated colonies.

A recent species of Pentacrinus, a genus largely represented in the lias and oolite, was brought in 1755 from Martinique to Paris, and described by Guettard. At long intervals rare specimens from the Caribbean Sea have been seen. On the 21st of July, 1870, Gwyn Jeffreys, while dredging from the Porcupine at a depth of two thousand metres, in longitude 39° 42′, latitude 9° 43′, procured a score of specimens. It would seem as if their excellent state of preservation would prove whether they were free or fixed. Thomson, who studied them, believed that the animal lives slightly attached to the soft mud, changing at will its abode, and swimming by means of its feathery arms. On the Talisman, the trawl was twice dropped to depths occupied by this Pentacrinus; and we decided, contrary to the prevailing opinion, that these animals live firmly fixed by the backward-curving tendrils, which grow from the terminal joint of the rod. These hooks, as it were, solder themselves to the bottom, and can be detached only by breaking.

We have attempted to show in our plate the character of the bottom of the sea on which Pentacrinus lives, as it was shown by the dredging made opposite Rochefort, at fifteen hundred metres. Pentacrinus Wyville-Thomsoni in considerable numbers covers the ground, forming a kind of living meadow, from which rise large Mopseas. The rocky ground was covered with beautiful corals, resembling flowers with the calyx opened; and in the midst of this living world moved hitherto unknown crustaceans (Paralomis microps A. M. Edw.) whose carapace was ornamented with fine spines. Actinometra (crinoids which become detached from their rods after full growth) were floating in the water, or fastened themselves for short intervals by their tendrils to the branches of the Mopseas. Pentacrinus and Actinometra were of a beautiful grass-green, the Mopseas of an orange color, the corals of a deep violet, and the crustaceans of a mother-of-pearl whiteness. This profusion of life, and this prodigality of colors, at fifteen hundred metres below the surface, certainly form two of the most wonderful facts which have been reserved for the naturalist to discover.

In 1827 Thomson found attached to Comatulas (free crinoids with no attaching rod) a Pentacrinus of small size, which he described under the name of Pentacrinus europaeus. This animal seemed to possess, in all the details of its structure, the characteristics of the fossil Encrinus and of the modern Pentacrinus. Ten years later Mr. Thomson, when again examining a small crinoid, was much astonished to see it suddenly abandon its rod, and begin to swim with its arms for some time, and then to re-attach itself by its tendrils. Continuing his studies, he saw the arms, originally branched at the summit, gradually assume the character of the arms of Comatula; and he was gradually brought to the knowledge that Pentacrinus europaeus was only a young Comatula.

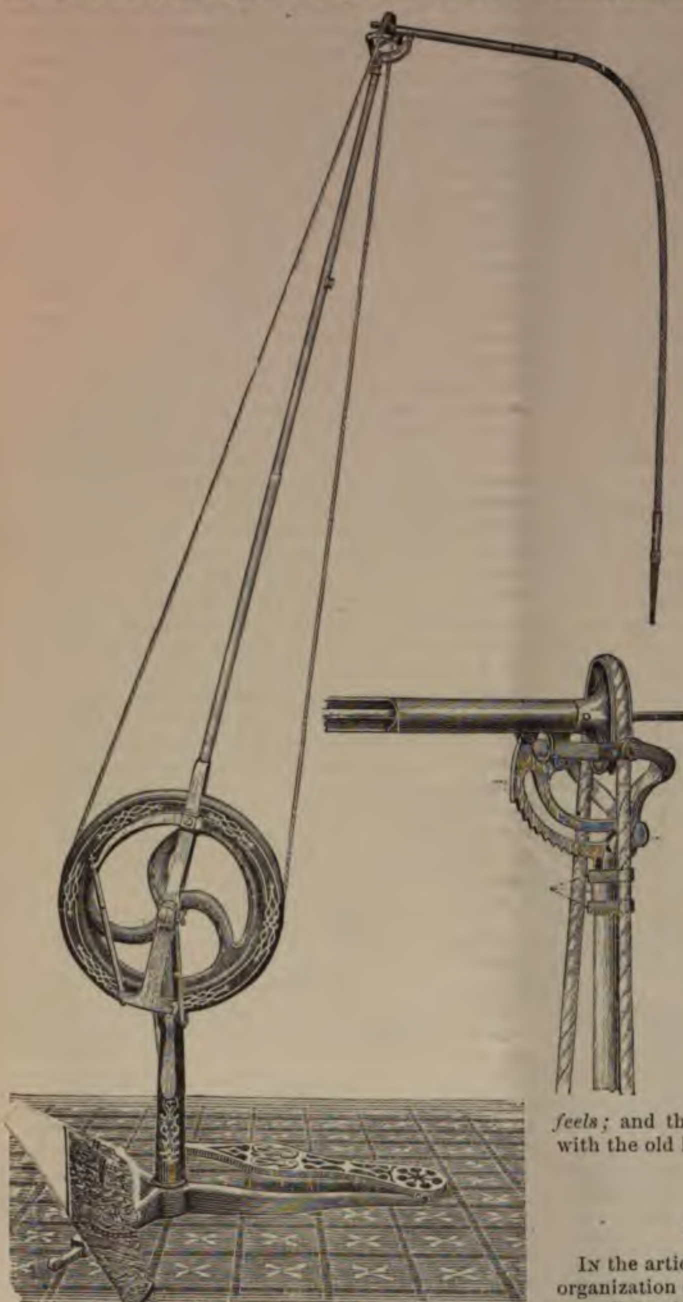
Comatulas are numerous at certain points on our coast, where they are found, according to their age, gracefully clinging among the sea-wrack, or sheltered under the pebbles accumulated on the reefs. Several species descend to a considerable depth, one being found abundantly at twelve hundred metres. At some places we saw Comatulas existing by thousands, and representing almost exclusively the animal life of the locality.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

New-York academy of sciences.

June 3. — Mr. G. F. Kunz read a paper on a new process of cameo or intaglio gem-engraving, in which he said, that, from his first experience in the dental chair, he received the impression that the machine used in tooth-drilling would be the proper one for engraving and cutting on stones similar to cameos and intaglios. In the engraving-lathe at present used, the tool revolves on a horizontal shaft, to which are attached tools of different size and shape; the Italians and French using a screw-thread, while the English make use of a lead head, which is simply fastened in by the revolving of the wheel. A set of tools or drills often numbers over a hundred. Mr. Kunz exhibited the S. S. White improved dental engine, which is somewhat similar to the other machines in use, and may be described as follows: A driving-wheel eleven inches in diameter is set in motion by a foot-treadle; and from this wheel the power is conveyed, by means of a cord of fibre or thin leather, to a pulley-head. To this is hinged a pivot-rod, extending from it as a flexible arm, which conveys the power to the drill through a steel or iron head-piece. The main advantage lies in the revolving-point being allowed so much freedom of motion by the flexible wire arm, that it ca[illegible] be placed in any position desired, and held i[illegible] position on the work instead of the work [illegible] on it. Any revolving-tool that can b[illegible] at will on the work, in any desired positio[illegible] the desired result; and this can be attained [illegible] exible driver, as in this machine. It might [illegible] ver, be improved. 1°. The points or drills [illegible] be made of softer iron, to hold the particles of [illegible] mond-dust more readily. 2°. The tool should [illegible] arranged to work more steadily, and thus overcome any possible jar in very fine work, although it has drilled a series of holes in a metal plate, which no engraver with the old lathe could place more closely. 3°. The driving-wheel should be heavier and larger, to attain more

power and a greater rate of speed. 4°. The wheel and treadle should be placed under a bench, and the



THE WHITE DENTAL ENGINE, APPLICABLE TO GEM-ENGRAVING.

flexible arm passed through its centre, in front of the workman. A machine of this kind might be used for all rough grinding-out; or, for some of the fine work, a diamond-pointed tool, the diamond being the amorphous carbonado. This would in all respects be a miniature rock-drill. Mr. Kunz had no doubt that with this tool, the diamond being properly secured, any stone softer than diamond could be engraved much more readily than with any known drill; and that for engraving on diamond it could also possibly be used, since the amorphous diamond is really harder than the crystalline form of this mineral. As engraving on this gem has been much more in vogue of late than ever before, its use in this field, also, would be required. It could at least make the round furrows, such as in ancient times were made by the bow-drill, and afterward by the diamond or emery-stone point, and then polished out by the finer particles of these minerals. One great advantage of this method is, that the very pulsation, as it were, of the artist, will be conveyed to the drill, thus imparting to the stone whatever artistic feeling he may possess, instead of the mechanical, unartistic effect so common with the work of the old machine. By this method, should it be given a fair trial, not only will the style of work be likely to be greatly improved, but a rapidity of execution will be attained that has never been accomplished by the old lathe-machine, even by the best workmen. Who would think of a sculptor holding the statue against the chisel, or of a violinist rubbing the bow with the violin? And yet the present mode of engraving is quite correctly illustrated in these apparently extreme examples. The conveyance of the pulsation through such a machine as this is really the same as the inspiration which a musician or an artist conveys to his instrument, his brush, or pencil: it is what he *feels*; and the graver cannot convey this pulsation with the old lathe.

NOTES AND NEWS.

IN the article in our number of last week, on the organization of an international scientific association, no sufficiently distinct reference was made to the committee appointed by the American association. Dr. Minot has called our attention to the omission, which we endeavor to make good by the following statement. The committee referred to was appointed in 1882 at the Montreal meeting of the American association

for the advancement of science, "to confer with committees of foreign associations for the advancement of science with reference to an international convention of scientific associations." The committee consists of Dr. T. Sterry Hunt, Mr. Alexander Agassiz, and Professor Simon Newcomb. If the British association responds, as has been suggested, by also appointing a committee, the official channels for the interchange of opinion between the two national bodies will be suitably established on both sides. We are unable to make any authorized statement as to what the American committee has done or proposes, but its membership justifies the conviction that it is capable of efficient action, wisely planned. We shall await their report with interest.

— The circular of the Philadelphia local committee announces that the local and general secretaries of the American association will have their offices in the library of Horticultural hall. The post-office will be in the Academy of music, where letters bearing the initials A. A. A. S. will be delivered.

In section B, physics, electricity will undoubtedly be a prominent subject of discussion. In consequence of the provision of congress for the appointment, by the President of the United States, of a scientific commission to conduct a national conference of electricians and investigations related to the international electrical exhibition, it is probable that official conferences of electricians will be held immediately after the meeting of the association, so as to allow all visiting scientific men interested in this department to participate.

The president of section E, geology, suggests that the following order be observed in the reading of papers: 1°. Geography and stratigraphic (post-archaean) geology; 2°. Geology of crystalline rocks; 3°. Mineralogy and lithology; 4°. Paleontology; 5°. Quaternary geology; 6°. Miscellaneous. As a large number of papers is expected, it is suggested that special days be assigned to the above topics in the order given. The subject of crystalline rocks will form a special topic of discussion. The presence of a number of British geologists will add unusual interest to the occasion. Special geological excursions will be arranged to places of interest in the vicinity.

It is proposed to effect an organization in section C, chemistry, under the title of the sub-section of agricultural chemistry. All chemists interested in the application of the science to agriculture are invited to attend this convention of agricultural chemists, to be held Monday evening, Sept. 10. The Association of the *American journal of agricultural science* will also meet during the week, and all persons interested in promoting this enterprise are invited to attend.

Special efforts have been made to render the meetings of section D, mechanical science, of unusual importance, invitations having been sent to a large number of specialists and mechanical and engineering societies to participate. Papers are expected on the subjects of standard bars, flat surfaces, screws, etc. Room will be provided for the erection of apparatus.

All botanical members are requested to call at the Academy of natural sciences as soon as practicable after arrival, and register: this will constitute them members of the American botanical club of the association, which was instituted at the Minneapolis meeting, and entitle them to the privileges of the same. Special excursions will be organized to the Bartram gardens, the pine barrens of New Jersey, and other localities of botanical interest.

It is expected that an effort will be made toward the formation of a sub-section on meteorology.

The proposed organization of an International scientific association will be brought forward for discussion. It is hoped that the British association also will take some action during its session at Montreal, to enable it to unite with the American association in a common effort to found such a congress. Those who are interested in the undertaking, who can make any suggestions or desire information as to the plans formed, are invited by the local committee to communicate with Dr. Charles S. Minot, No. 25 Mount Vernon Street, Boston, Mass., who, in accordance with the wish of the permanent secretary, has assumed charge of the correspondence relating to this matter. In this connection it is worthy of note that the local committee has sent invitations to more than two hundred foreign societies, inviting them to send representatives to Philadelphia. A number have accepted; and this increase in the number of foreign scientific men will add to the importance of the movement. Among the American societies which will meet simultaneously in Philadelphia are the American institute of mining engineers, the American institute of electrical engineers, the Pennsylvania state agricultural society, the Agassiz association, and the Association of collegiate alumnae. For all business concerning papers, membership, etc., address F. W. Putnam, Hotel Lafayette, after Aug. 20; and for all local business, transportation, and rooms, address local secretaries, H. C. Lewis and E. J. Nolan, at the Academy of natural sciences.

— The President has selected the following as members of the electrical commission to conduct experiments on the occasion of the exhibition at the Franklin institute: Prof. H. A. Rowland, Baltimore; Professor John Trowbridge, Cambridge; Prof. G. F. Barker, Philadelphia; Prof. R. A. Fisk, San Francisco; Prof. M. B. Snyder, Philadelphia; Prof. J. Willard Gibbs, New Haven; Professor Simon Newcomb, Washington; Prof. E. J. Houston, Philadelphia; Prof. C. A. Young, Princeton; Dr. W. H. Wahl, Philadelphia.

— Some weeks ago a plan for bringing certain subjects for debate before the chemical section of the American association for the advancement of science, at its approaching meeting in Philadelphia, was considered by the fellows of section C, and has resulted in the following selection: 1°. To what extent is the hypothesis of 'valence' or 'atomicity' of value in explaining chemical reactions? 2°. What is the best initiatory course of work for students entering upon laboratory practice, and what are the best methods of illustrating chemical lectures? These subjects, if

approved by the standing committee, will be offered for public discussion in the sectional meetings at such time as the committee may determine, probably on Monday and Tuesday, Sept. 8 and 9. In addition to the above, the following subjects have been carefully considered by some of the members, and papers or discussions on them may be expected, if the committee are able to arrange for them upon the daily programmes: Fermentation; Adulteration of food and drugs; Thermo-chemistry and chemical theory.

— With a view of more generally disseminating the results of scientific investigation, and of facilitating the work of the student in natural history, the following members and officers of the Academy of natural sciences, Philadelphia, have associated themselves into a bureau of scientific information, whose function shall be the imparting, through correspondence, of precise and definite information bearing upon the different branches of the natural sciences. It is believed by them, that, through an organization of this kind, considerable assistance can be rendered to those who, by the nature of their surroundings, are precluded from the advantages to be derived from museums and libraries. As the organization is of a purely voluntary character, it is to be hoped that no unnecessary burden will be imposed upon its members by communications of an essentially trivial nature. All correspondence must be accompanied by a return stamp (two cent), and may be addressed to the following: Joseph Leidy, M.D., Mycetozoa, Rhizopoda, Entozoa, Vertebrate paleontology; Edward Potts, Pond life, Fresh-water sponges, and Bryozoa; George W. Tryon, jun., Conchology; Benjamin Sharp, M.D., Worms, Annelids, Histology; G. H. Horn, M.D., North-American Coleoptera; H. C. McCook, D.D., Ants, Spiders, Insect architecture; Henry Skinner, M.D., North-American moths; Eugene M. Aaron, Diurnal Lepidoptera; W. N. Lockington, Echinoderms, Fishes; Spencer Trotter, M.D., North-American ornithology; Thomas Meehan, Exotic and cultivated plants; J. H. Redfield, Ferns and North-American phanerogamic plants; J. T. Rothrock, Vegetable physiology; F. Lamson Scribner, Grasses; H. Carvill Lewis, Mineralogy, Glacial and stratigraphical geology; Angelo Heilprin, Invertebrate paleontology, Physiography, Dynamical geology; D. G. Brinton, M.D., Ethnology, American linguistics, and Archeology; Harrison Allen, M.D., Teratology; J. Gibbons Hunt, M.D., Microscopical technology; E. J. Nolan, M.D., Bibliography of natural history; Professor Harrison Allen, chairman; Professor Angelo Heilprin, secretary. It is to be clearly understood that the scope of the organization does not embrace considerations of a purely professional character, such as mineral or chemical analyses, nor the determination of collections, except by special agreement. Departments not represented in the above titles will be filled as early as practicable: correspondence pertaining to such should be addressed to the secretary. In all other departments the respondents may be addressed directly, care of the Bureau of scientific information, Academy of natural sciences.

— Lieut. A. R. Gordon of the royal navy, superintendent of the Canadian meteorological service, sailed from Halifax, June 22, in the steamer Neptune, with a party of observers, to establish stations along the Hudson's Strait. The crew, with the explorers, will in all number fifty-five men. The expedition will first call at Nain, on the Labrador coast, and finally at Ramah, the northernmost station on the Atlantic coast, and but a few hundred miles south of Cape Chudleigh, at the entrance to the strait. Eskimo interpreters will be engaged at one or more of these Labrador stations. Seven stations in the strait will be established, as follows: No. 1, at Cape Chudleigh, at the south-east entrance of the strait; No. 2, on Resolution Island, at the north-east entrance of the strait, and about forty-five miles across from No. 7 station; No. 3, at Cape Hope, or on the south side of about the centre of the strait, and about two hundred and fifty miles from stations 1 and 2; No. 4, directly north of No. 3, on the Upper Savages Islands; No. 5, on the south-east end of Nottingham Island, and about two hundred miles from No. 4; No. 6, on the south side of Mansfield Island, and a hundred and fifty miles from No. 5; No. 7, at Fort Churchill, four hundred and sixty miles from No. 6.

— By order of the secretary of the navy, a board, consisting of Commodore Luce, Capt. Sampson, and Commander Goodrich, has reported upon the establishing of a post-graduate course, or school of application, for officers of the navy. It recommends that the leading subjects of the course should be the 'science and art of war,' and 'Law and history.' Subsidiary to these, instruction will be given in ordnance, torpedoes, and hydrography. These latter courses will consist partly of instruction in the higher mathematics and the physical sciences, and partly of practice at the Washington navy arsenal and experimental battery and the Newport torpedo station.

Only officers of and above the rank of lieutenant are to be allowed to take the courses. In the two main branches the students are to come to the school, and the subjects are to be taught by eminent specialists. For the instruction in science, the students must go to the instructors, wherever such and the necessary laboratories are to be found. For this and other reasons, the board recommends Newport for the site of the school, that the students in science may avail themselves of the facilities about Boston.

— The Detroit *Free press* reports a fall of a light dust on Lake Michigan on June 13. The dust covered the ground about Wangoshance lighthouse to the depth of an inch.

— The paper promised by Professor Bonney for the Montreal meeting of the British association will be on the archaean rocks of Britain, and not on the archaean rocks of Canada.

— The director of the meteorological observatory of Turin, Father Denza, is organizing observations on board the Godard captive balloon, which ascends to an altitude of two hundred to three hundred metres at the Turin exhibition.

SCIENCE.

FRIDAY, AUGUST 8, 1884.

COMMENT AND CRITICISM.

APROPOS of the appointment of the electrical commission mentioned last week in our notes, is not the manner in which candidates are selected for scientific appointments at Washington worthy of serious consideration? There seems to be no scientific authority there who feels entitled to come forward in such cases, and represent the views of scientific men. If the latter are appealed to, to come forward themselves, the almost universal answer is, that they do not feel that their opinions would receive serious consideration at the hands of the appointing power; and that, if the authorities really care for their opinions, it is very easy to ask for them. But, unfortunately, business at the national capital is not arranged on any such system. An appointing power is not an active personage who investigates for himself, but the occupant of a seat at an office-desk, waiting for people to come forward and present their views. This personage does not assume that any one has any views unless he comes forward with them, and is not disposed to go around in search of opinions as long as he finds himself plentifully supplied with the article, ready-made, and thrust upon him. If asked to obtain the views of learned men, his reply would be a general invitation to all that class to come forward. Let the reader imagine, if he pleases, an 'industry' or an 'interest' too modest to address the authorities.

The bad effect of this state of things need not be dwelt upon: the practical question is, how it can be remedied. The only remedy is to have some central scientific authority, in intimate relations with the administration, ready to come forward and represent the scientific opinion of the country on all occasions when the interests of science are involved. If we had a department of science, its head would naturally perform these functions: in the absence of this agency, and of any special statutory provision, nothing can be effectively done, unless our leading scientific men will lay aside modesty, and accept the disagreeable features of the situation. An unofficial representative, on confidential terms with the leading members of the administration, might be nearly as effective as a department. But, mortifying though it may be, the general rule is that official position, as the responsible head of an establishment of some kind, is necessary to enable any man to command any real weight.

A STRIKING similarity may be observed between the history of names of individuals among men, and the history of scientific names given to natural objects. In zoölogy the species or variety stands in the same relation to the naturalist as the individual man stands to his fellows. The object of names is in both cases to distinguish absolutely the species, variety, or individual, from others about it. When men live in comparatively small communities, and each individual leads a stationary life, one name has generally been found sufficient; but in larger communities, or where a constant mingling of the people takes place through political commotions or increased facility for travel, a necessity arises for binomial or trinomial, or even longer names.

Thus in England, in Saxon days, one name, as a rule, sufficed; but after the conquest binomial names were gradually adopted, though these had an earlier origin in France. Binomial nomenclature answered until the eighteenth century, when trinomial names began to be introduced, and now prevail. These now are often insufficient to meet the wants of modern man, to distinguish him as an individual, to

enable him to receive his telegrams and letters when in the midst of such centres of population as London, Paris, Berlin, or New York; and thus the evolution of the four and five divided polynomial names is actually occurring, which, before another half-century, will doubtless be as common as trinomial names are to-day. In the United States the changes have taken place more slowly than in England, and in that country less rapidly than in Germany and France. In America the trinomial system began to be adopted about the middle of the eighteenth century, but did not acquire prominence until well into the first quarter of the present century. In these remarks regard is paid to the mass of the people; for the nobility, and in some regions the pride of descent, have hastened or modified the general law of name evolution, while even in England, in some isolated districts, one name alone quite recently sufficed.

Turning to natural history, it can be seen that in mineralogy and lithology the species are comparatively few, and a single name is used; although traces of a binomial system can be seen in the latter, in such names as quartz porphyry, olivine diabase, hornblende andesite, etc. Several attempts, indeed, have been made to introduce a binomial nomenclature in mineralogy, but they have always failed because both unnecessary and unnatural. In zoölogy and botany, in the olden time, one name was used; but as these sciences increased in exactness, and in the number of their species, the binomial system was introduced by Linné. This has answered the purposes of science for a long period; but the multiplicity of the species and varieties known has now become greater than the capabilities of that system, and a polynomial nomenclature is being surely evolved. Indeed, triple and quadruple names are as inevitable to designate species and varieties, of animals at least, as such names have been found to be for individual men; and the wise and philosophic naturalist is undoubtedly the one who adapts his system to the tendency of the times, — the inevitable.

Two modes seem available to meet this, — one by the use of letters or numerals; and the other by the addition, to the generic and specific names now employed, of a third or even fourth name, to indicate the variety and sub-variety so far as need be. The former finds an example in the use of 'sen.,' 'jun.,' '1st,' '2d,' and '3d,' added to distinguish individuals, and of the Roman numerals affixed to the names of kings. This method is confessedly inconvenient and of limited use. The second method accords with the custom of mankind, and would never have been adopted if it had not been the easiest, best, and most natural system for man and his capabilities. The trinomial system of zoölogy (genus, species, and variety) has its olden prototype in the Roman name system, — gens, family, and person; or nomen, cognomen, and praenomen, — although the order of arrangement differs; e.g., Caius Julius Caesar, Lucius Cornelius Scipio. Names, for example, like Turdus fuscescens salicicola would appear, from the above, to be of proper form; but such as Eutaenia sirtalis sirtalis, or Heterdon platyrhinus platyrhinus, are as absurd as it would be to name a person John John Smith or George Washington Washington. The similarity of the laws and methods of development of nomenclature, both for mankind in general and for the naturalist, is not remarkable; for it merely displays the mind of man with its capabilities and limitations, acting on the same problem, — the separation of specials from generals. The resemblances in both cases have been carried out so fully, that even the organic chemists, in their nomenclature, rival that of the highland Scotchman in his palmiest days, and from the same cause, — the line of descent.

It is a good sign that the importance of the explorations undertaken by the Peabody museum is acknowledged by others than those in the immediate vicinity of Cambridge. The broad and national character of the museum is thus slowly meeting with appreciation. When we recall the fact that this is the only museum in the country founded and conducted for the

single purpose of the study of man, it seems impossible that it should long remain without a much larger support from friends of American archeology and ethnology. We hope that the trustees will be encouraged in their efforts by a large increase to the subscriptions for American explorations, in addition to those mentioned in our notes.

European naturalists regard the attention paid in this country to economic entomology, and the aid that has been given it by various states and by the general government, as one sign of 'a practical people.' With all the specialization in instruction in the foreign universities, we are not aware that there is more than one which supports a professorship of entomology. This is Oxford, where the venerable Professor Westwood honors the Hope foundation. In this country, Harvard and Cornell each have their full professorship of this science; and to the latter a summer school, having special reference to agricultural entomology, has now been attached. This seems more appropriate than many of the summer schools now so much in vogue, inasmuch as the objects of study are at this season in the height of their investigations into the power of crops to sustain insect-life. To further the interests of the school, the trustees of Cornell university have relieved Professor Comstock of his duties during the winter *semester;* and an unusually good opportunity is thus afforded to teachers, as well as others, to familiarize themselves with the principles of this branch of economic science.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Some United States geologists, and the propylite question.

Your reviewer of the recent publications of the U. S. geological survey incorrectly states that Dr. Becker does not give Rosenbusch credit for his prior advocacy of the view that propylite is a modification of andesite (*Science*, iv. p. 67), for Becker does so on p. 90 of his 'Geology of the Comstock lode;' but your reviewer ought to have stated that Wadsworth was the first American to advocate this relation of propylite and andesite, which he did in a paper published before that of Rosenbusch. In Wadsworth's paper it was remarked, that his microscopic studies of the Washoe and other western propylites, collected by Richthofen and the Fortieth parallel exploration, had led him to conclude of these typical propylitic rocks, that "the propylites are all altered andesites, with which species their chemical composition agrees; and that the diagnostic distinctions that Professor Zirkel has placed between the andesites and propylites did not hold good, even in the specimens that he described, as would have been readily seen, had he given complete descriptions instead of the very imperfect and often inaccurate ones that have been published. The distinction between these rocks is simply in the degree of alteration; and they pass directly into each other."[1]

Now, although Messrs. George F. Becker and Arnold Hague are fully known to have knowledge of this publication, they not only ignore completely the priority of Wadsworth, but also use language which would cause any reader not conversant with the subject to believe that Becker was the first American to oppose the species propylite.

In connection with a professed history of the discussion of the Washoe rocks, Becker states, "Baron von Richthofen based the independence of the new rock propylite largely upon the occurrences in the *Washoe district.* Later investigators in the same field, without exception, have adopted his views. Professor Zirkel's characterizations of the microscopical peculiarities of propylite were also founded chiefly on the *Washoe* occurrence. Though at the beginning of the present investigation [April, 1880] I was fully persuaded of the independence of propylite, I subsequently found reason to doubt it; but to prove a negative is notoriously difficult, and the great authority of my predecessors made the task still more onerous."[2]

Mr. Hague writes, "Recently Mr. George F. Becker, in his work on the Washoe district, made a thorough investigation of the so-called propylite, and as a result denied the independence of the rock-species. . . . We quite agree with him, so far as the non-existence of propylite as a distinct rock-species in the Great Basin is concerned."[3]

Any one who is conversant with the storm Wadsworth's before-mentioned paper of 1879 excited will have no difficulty in understanding why it is that these and some other geologists, who are now standing on almost if not quite identical ground with him, should proceed in such a manner.[4]

M. E. Wadsworth.

Museum of comparative zoölogy,
Cambridge, Mass., July 21.

Swarming insects.

The editor was slightly unfortunate in his suggestion appended as a note to the letter of Mr. Abbott (*Science*, No. 77). I have just returned from Lakeside, Ottawa county, O., where the phenomenon spoken of by Mr. Abbott was witnessed almost every day for more than two weeks. The pulsating swarms were, beyond question, the 'Canada soldiers,' a species of Ephemera.

During the first ten days of the present month

1 *Bull. mus. comp. zoöl.*, 1879, v. 285.
2 Geology of the Comstock lode, 1882, p. 33.
3 *Amer. journ. sc.*, 1884 (3), xxvii. 454.
4 See, further, Proceedings of the Boston society of natural history, 1883, xxii. 412–432; and 1881, xxi. 243–274.

this insect swarmed in such numbers as to cover every exposed surface, and literally to darken the air to a height of fifty to seventy-five feet. When the Ephemerae emerge from the water, their flight is weak and uncertain. Instinct teaches them that they are carrying an extra armor, and they seek at once the nearest support as a place on which to moult. At such times these insects are as easily disturbed as a swarm of bees. A gust of wind from an unexpected quarter, giving a slight rustle to the leaves, will often cause them to rise in clouds from each branch. This motion seems a circling one; but the appearance is probably due to the fact that many of the insects are moving back upon the branches, while others are still ascending. No other insects were at all common along the lake during this time. It may be worth placing on record that that venerable citizen known as the oldest inhabitant was speechless in the presence of these swarming millions. His memory could not recall another year in which the numbers were worthy to be compared with those of 1884. It will be impossible to convey in words an adequate conception of this invasion to those who have never witnessed any thing of the kind.

Near the dock at Lakeside there is an electric lamp suspended about twenty feet above the ground. As might be expected, this became an object for attack as soon as the current was turned on in the evening. On the morning of July 7 the layer of dead insects covered an area of not less than twenty-five square feet, and was fully *six inches deep immediately underneath the lamp*. Kelley's Island, four miles distant, appeared all the while as if enveloped in such a cloud of dust as rises over a race-course. On the evening of July 6 a wind compelled the insects to fly very close to the surface of the water, and their numbers appeared fully as great as the snowflakes of a winter's storm. During these ten days the invasion extended along the entire southern shore of the lake, from Buffalo, through Cleveland, Sandusky City, and Toledo, to Detroit. After a rain-storm the water of the lake was dense with them to a depth of at least two feet. Along the beach they were gathered in windrows. As far as my observation goes, fish will not eat the dead insects, but greedily devour living ones. The minnows are very expert at this work, rarely failing to make a capture if the insect has touched the water.

According to Packard, all the Ephmeridae pair while on the upper surface of the water. This is not strictly correct, for any afternoon one could see thousands of couples flying in the air and at elevations as great as fifty feet. When this took place over the water, the couple almost invariably fell into the lake, and was devoured by the fishes. Is nature producing a stronger-winged variety?

Edward T. Nelson.

Ohio Wesleyan university,
Delaware, O., July 28.

[The phenomena seen by Professor Nelson, as described by him, appear to be different from those witnessed by Rev. Mr. Abbott, and in all probability a wholly different insect was concerned. The myriads of Ephemeridae mentioned by both writers have been not unfrequently witnessed. A woodcut of a street-lamp in Cleveland, swarming with Ephemeridae, will be found in Morse's 'First book of zoölogy.' We have ourselves seen, from a long distance, windrows of their dead bodies and exuviae along the shore of Lake Winnipeg for very many miles, while the water of the lake was so covered with them that one could not dip up a cup of clear water. — Ed.]

Man and the mastodon.

Having had occasion recently to look over numbers of the *American journal of science* of forty years ago, I have met with several notices of archeological interest. Among them is the following, in an article on the suburban geology of Richmond, Wayne county, Ind., by Dr. John T. Plummer, vol. xliv., 1843, p. 302: —

"A tusk [of the mastodon or mammoth] was exhumed from the gravel, fifteen feet below the surface, while excavating the Whitewater Canal, near Brookeville, about thirty miles south of Richmond; [and] a *club-shaped* implement, formed apparently of cliff-limestone, was also taken out of the gravel ten feet below the surface, near the spot where the tusk was found."

This implement is described as "seventeen inches long, rounded at one end, tapering towards the other extremity." I do not remember to have seen any reference to this in recent works; but as Dr. Plummer seems to have been an intelligent observer, and as he calls attention to the resemblance of this implement to an 'Indian hommony pestle,' and to the remarkable fact that it was found under the above conditions, the note should be borne in mind, and other implements looked for in the gravels of the vicinity named.

In the same article are noticed an ornament called ivory by Dr. Plummer, but probably shell, as like mistakes are often made (p. 301), mounds (p. 313), and (on p. 303) "several sticks, and a chip having palpable marks of an edged tool upon it," found nearly thirty feet below the surface in excavating a well in Richmond.

F. W. Putnam.

THE MADISON EDUCATIONAL CONVENTION.

The meeting of the National educational association at Madison, Wis., which closed its sessions on Friday, July 18, was the largest ever held in this country, and probably the largest of its kind in the world. Every state and territory in the Union was represented, and over six thousand teachers were on the ground. The weather was fine, the town beautiful, and very bountiful in its hospitality, the excursions numerous, the speakers eloquent, the exposition, on the whole, more instructive, and in some departments larger, than at Philadelphia in 1876. Everybody was there, was heard, and most who desired it had some office provided for them, and had their names and words spread over the land by the efficient agent of the associated press. Half a dozen meetings were going on at the same time, and manuscript enough to run as many educational journals for the year was evolved; so that those who went will not need to read for one year. There were committee meetings

to fill every hour of the day; and more than once an honest teacher was said to have waked in the morning to find, that, in the small hours of the night before, he had been made president of some new society of which he had never heard. The agents of the railways, with fascinating chromos of attractive scenery, were organizing excursions at fabulously cheap rates for the neighboring lakes, and even for Alaska, whither a large party started the last day. Dignified and super-subtle agents of the many publishing-houses buttonholed every man who could and would help them, with an assiduity in every way worthy the greatest educational show on earth. Superintendents who needed new departures for their constituencies were seeking the support of the convention for all sorts of schemes and reforms. Societies for humanity to animals, temperance clubs, renowned champions of rights for women, Catholicism, represented by a no less adroit and subtle propagandist than M. Capel, were all on hand, and striving by every means in their power to make their cause heard in what all have come to feel to be the centre and source of all influences that are to be permanent and pervading in the land; viz., the public schools. Private, high, normal, industrial, collegiate institutions had meetings of their own more or less numerous. Dr. Graham Bell and the deaf-mutes, Gen. Armstrong and the Indians, Mr. F. Adler and his workshops, the Concord summer school of philosophy, the Quincy reform, were all represented by distinct addresses. An international league was organized, with nearly a score of officers, on the suggestion of an unknown enthusiast at Bonn, Germany; and at the end a very long series of resolutions, expressing the sentiments of a few end men on most of the open questions in the broad sphere of modern life, were approved; and then with fireworks and cannon, and bands of music and illuminations, and out and in door eloquence, the vast assembly dissolved.

This association is not a ring, though its offices and policy are entirely in the hands of a very few men; for its honors are empty, its offices gratuitous, and some of the best educators keep carefully aloof from it. That others are not recognized shows a want of wisdom at the centre, which reveals the weakness and instability of the entire organization. It was never more apparent than at this meeting, that education is, in this country, not a science, nor a profession, in any extended or respectable sense. Contrast the dismal time-killing trivialities which frittered away the time of the larger meetings, the emptiness of some of the addresses, the egotism and ignorance of others, with the method of a meeting of a scientific association.

Worst of all were, perhaps, the dismal hours of the so-called philosophy of education: any thing more stultifying and anti-pedagogic than most of this cannot be imagined. If a teacher can teach, he can interest a convention, or else is sure to have the sense to keep silent. By this test very few *teachers* were heard at Madison. No more earnest and inspiriting address was heard than Col. Parker's, whose iconoclasm the managers greatly fear. He is in earnest in his work; and no man was heard with greater interest, though perhaps rarely without some feeling of strong dissent. It is said, teachers are not in the mood for earnest work at such assemblies. This is often true of the eastern, but not of the western teachers; their enthusiasm is most inspiring, and may shame, as it is rapidly distancing, even the best of the more routine methods of the East. In view of this eagerness, some of the papers admitted by the president were a shame to him, and an insult to the intelligence and zeal of the hearers. There should be, before another meeting, a board of examiners to decide on the merits of papers, less with reference to names, and more to matter.

On the whole, the address of President Bicknell was wise and suggestive and all-sided. His organization of this year shows great administrative capacity, and a clear sense of the needs of the hour. What was wanted this year was mass, quantity, if only to show to outsiders the strength of educational interests. But progress is now so rapid here, that the wants of another year will be very different.

We hope the standard of the new president from the West will be quality first, and quantity afterward. Although in one sense he can hardly equal the success of this year, a higher kind of success desired by those who voted for him is possible. If he has the strength and wisdom to make it against all the solicitations which will tempt him, the most important new departure since the association was founded may be quietly made next year, even by a very small convention, in which quality shall be made the touchstone of all.

A BURROWING SPIDER.

IN the somewhat heavy soil of certain fields, where but a scanty herbage thrives, the cave-making spider (Tarantula arenicola, as identified by the Rev. Dr. H. C. McCook) has excavated so many of the nearly perpendicular and cylindrical burrows, that the place is almost honeycombed, and the surface is conspicuously dotted by the irregularly five-sided towers erected above each opening. The burrows vary from one-quarter to three-quarters of an inch in diameter, and in depth from eight to twelve, or even twenty, inches; the smaller being formed, it is said, by the young, which enlarge them with their growth. The walls are compact and smooth, but without lining. Towers in other localities have been observed two inches high: none I have seen are above one inch, the majority being still less.

Among my captives, the most active workers are an adult and a half-grown individual, between whose actions, while digging, slight differences are observable. In a glass jar they refused to do more than attempt to escape by unavailing efforts to scale the sides, but, when set free in the garden, they at once began to exhibit their manner of burrowing, and disposing of the excavated earth. Most of the labor is performed by the large and strong mandibles, with the probable assistance of the fore-legs. A pellet of earth, frequently a third of the worker's cephalothorax in bulk, is loosened as the spider labors head downward, and is seized by the mandibles. The young spider turns at the bottom of the burrow, and ascends, head first, to the edge of the aperture, where the pellet is held just above the surface; then, by a blow from both fore-legs, it is thrown to a distance varying from four to twelve inches, usually falling in particles, so that no fresh earth is noticeable near the burrow-entrance. The half-grown individual then backs down the tube, and resumes work below. The mature spider, while the pit is shallow, ascends backward with the load, comes entirely out of the orifice, turns around, and, having popped the abdomen into the opening, throws away the pellet. She rests for a few moments, again turns within the cave, and descends, head foremost. Before returning to work below, however, she often carefully examines the edges of the burrow-entrance, and, if the earth has become dry and friable, strengthens it by threads of web, applied by longitudinal strokes of the spinnerets; and, if her movements have broken down the margins, she places her head under the edge, pushing and lifting the earth in a way suggestive of a dog's method of heaping dirt on a bone with his nose. She then applies more web, and resumes her digging. But, as the burrow deepens, the mature spider also turns while below. I have, however, never observed a young individual bring up a pellet backward.

That the spinnerets of this species take any part in pellet-making is improbable. Mrs. Mary Treat, while studying Tarantula turricula, observed their application to the earth-mass before its ejection. It is likely that Tarantula arenicola relies solely on the cohesion of the moist particles, without the addition of strengthening web, as I have repeatedly witnessed the dry soil of the field crumble to sand before the spider could get the pellet quite out of the tube.

The young specimen brought up a load at intervals varying from two to five minutes; and a cavern half an inch across and about one inch deep was excavated in an hour and a half. While deepening a burrow, a young spider in the field worked somewhat faster. Assuming a pit to be of the uniform width of three-quarters of an inch and twelve inches deep, the Tarantula must carry out the comparatively enormous amount of 5.31 cubic inches of earth.

The towers are usually composed of short pieces of grass (fig. 1) placed above and across each other in an irregularly five-sided wall. Occasionally small twigs are used. Indeed, almost any light object will be utilized if within reach, for the spider will not leave the burrow to search for materials. If nothing is attainable without such an effort, she will erect a low wall of earth. In several instances towers have been destroyed, and the ground cleared for a space of three inches radius; and from another place the sod was removed: but, in

every case, the spiders raised a bulwark of earth, one having attached a single sliver of pine shaving, the only thing within her reach. At times the grass is curved around the opening, as if a wisp had been taken, and the tower formed at almost a single stroke, without the labor involved in placing each blade separately. Near the favorite field, a housewife, in the annual frenzy of house-cleaning, had thrown out a quantity of coarse straw, which some of the Tarantulas utilized by erecting towers (fig. 2) of comparatively immense straw logs. Two miles from the latter was found a lofty edifice (fig. 3) built of large pieces of brown, partially decayed wood from an old railroad tie. Mrs. Treat has witnessed their construction by another species. I have not observed the entire process.

Fig. 1.

The spiders' favorite position is a crouching one at the summit, the legs within the tower, and supported by the walls. At the sight of any approaching object, they dart backward into the burrow. They are not disturbed by surface vibrations. Footsteps, even the passage of a heavy wagon within five yards of the pit, do not affect them; but the slightest movement of the observer, two feet distant, or the sudden swaying of a bush, sends them to the burrow immediately. Dr. H. C. McCook, writing in a popular magazine, says of the use of these erections, that "they probably serve as watch-towers, from which the keeper may observe the approach of her enemies," as an attraction to roving insects, and perhaps to prevent flooding of the cavern by rain. The towers in this locality are far from being waterproof: they are used exclusively, I think, to facilitate the capture of food. But observers, so far as I am aware, have made no statements as to the method of food-capture, when the food fails to voluntarily scale the walls.

The towers are observatories and transmitters of signals to the spider when below. From them she scans the field, as the robber barons of the olden time, from their battlements, watched for the coming of the caravan. The spider peers through the scanty grass-blades, selects her victim, and, as I have witnessed, leaps from the summit to seize the prey. I have seen her spring at a fly on the ground, missing it, of course. But she does not always wait for food until the pit and tower are completed. I have seen her dart from the edge of an unfinished burrow, capture an ant three inches distant, and retire to the shallow cave. Ten minutes later she re-appeared empty-handed, and almost immediately attempted to seize another near by, but failed to do more by her frantic efforts than scrape up a heap of loose earth.

The towers are so loosely constructed that an ant can scarcely run over the walls without making enough rattling to admonish the concealed spider, which at once hurries to the top, and, if the insect is acceptable, takes it in. A black ant running over the foundations almost invariably brings the spider up; and the gentle tapping of a straw, or even dragging a straw across the dead grass in contact with the walls, is quite sure to be followed by the arachnid's appearance. The sense of direction, or the ability to perceive whence the disturbance proceeds, is well developed. The spider always ascends on that side to which the straw is applied, and the same individual

Fig. 2.

Fig. 3.

can be brought to each side in succession. The depth of the cavern seems to have little effect. I have called up the occupant from a burrow which subsequent examination has proved to be eighteen inches deep. Unless she has been deceived several times, she usually runs up rapidly, and will occasionally snap at the end of the straw. While experimenting, it is hardly possible to avoid introducing fragments of the tower, or adherent particles of earth, and it occurred to me that these might be the call to which the spider responded; but sand from an ant-hill, sprinkled in freely, had no effect.

Mrs. Mary Treat, writing of another species of Tarantula, says that all food-remains were ejected in the same way as the earth pellets. Tarantula arenicola is not so neat. The earth beneath old burrows is often darker than the walls, and densely filled with fine rootlets. It is probably darkened and enriched by the spider's excrement and food-remains. From burrows in the field it is the rule to take masses of *débris*, which consist of the spider's exuviae, the heads and legs of ants, the elytra and other chitinous parts of beetles, with fragments of insect-wings. It seems that the dead and empty bodies are torn to pieces, and scattered at the bottom. This was done by a captive which would not dig, but which accepted maimed flies. After extracting the juices, the spider tore the body into fragments so small that only careful search could find them. In but two instances have I observed an ejection of food-remains. A mutilated fly was seized from a tower, and twenty-four hours later I did find what appeared to be the desiccated remains. In the second case, two spiders were fighting fiercely when set free at evening, near the burrow of a small specimen in the garden. During the night the occupant of the burrow was dislodged, and the vanquished spider had been dragged into the pit which the conqueror had enlarged, and whence, in the course of the morning, fragments of the dead body were thrown out, among them the abdomen severed from the thorax, but not otherwise mutilated. Occasionally, also, an elytron can be found near a tower in the field.

This disposition of remnants is somewhat remarkable; since spiders in general are cleanly, and since this one is particularly intolerant of intrusive objects. A straw or stem dropped into the burrow is immediately carried up, and tossed away. The only instance observed, where a young spider ascended backward, was when trying to get a heavy stick out of the pit: having lifted in vain, she attempted to pull.

Noticing the fondness for ants, a number of bran-cracker crumbs were sprinkled at a distance of six inches from the tower, and an ant was soon struggling under a load larger than itself. Suddenly the spider on the tower started, erect and rigid: she leaped to the ground, she ran six inches, she seized that bit of cracker, and retreated with it to her burrow, leaving the emmet on its back in the dust. For two hours she remained below. The following day I twice witnessed the same performance. The spider once overran the crumb, and so lost it. At the third time, the piece of biscuit became wedged in the tower as the spider was running in backward, and I plainly saw her nibbling at it. During a momentary absence for forceps to remove it, to examine for marks of mandibles, the spider carried it down and out of sight. The fragments were not touched, except as they were being borne about by the ants. Is it usual for spiders to take any but animal food?

DR. ALFRED C. STOKES.

THE EXPLORING VOYAGE OF THE CHALLENGER.

(*Second Notice.*)[1]

PROFESSOR HERDMAN has published the first part of his memoir upon the Tunicata (vol. vi., 296 p., 37 pl.), which treats solely of the 'Ascidiae simplices,' the composite and pelagic forms being reserved for future consideration. From the historical preface to the index, this report is a model of systematic arrangement; the bibliography, and the chapter on anatomy and classification, being worked out with especially elaborate care. The most important generalizations reached are: 1. These simple ascidians are not numerous in the northern hemispheres, are comparatively scarce in tropical latitudes, and attain the greatest abundance in southern temperate regions; 2. Although simple ascidians occur in very deep water, and are fairly represented in the abyssal zone, they are chiefly a shallow-water group, and are most numerous around coasts in a few fathoms of water; 3. The occurrence of simple ascidians does not depend upon temperature or character of bottom. The discussion of questions affecting the Tunicata as a class is reserved for the second part of the report. The phylogenetic table on p. 286 is of great interest.

[1] See No. 66.

There still remain to be published a number of reports upon Mollusca, — Huxley on the cephalopods, Boog Watson on the gasteropods, E. A. Craven on the pteropods and heteropods, Rudolph Bergh on the nudibranchiates, E. A. Smith on the lamellibranchiates, and Busk on the Polyzoa; the first instalment of the latter paper being announced for the next volume.

In his report upon the Brachiopoda (vol. i., 67 p., 4 pl.; also *Proc. royal soc.*, xxvii. p. 428), Professor Thomas Davidson of Brighton discusses the 31 species and varieties obtained, and presents a catalogue of the recent species at present known. Although the dredge was put down at 361 stations, brachiopods were found only thirty-nine times. The greater bulk of known species live at comparatively moderate depths, few as deep as 500 fathoms, and are specifically rare from 500 to 2,900 fathoms. It is also shown that the same species is capable of existing at different depths, without any observable modification in shape and character. Frequent allusions are made to the American authorities Dall and Morse, the opinions of the former being referred to on almost every page.

THE DREDGING AND SOUNDING APPARATUS ON BOARD THE CHALLENGER. (Copied from *The Atlantic*.)

Dr. F. Buchanan White, in his Report on the pelagic Hemiptera (vol. vii., 82 p., 3 pl.), discusses the interesting oceanic insects belonging to the genera Halobates and Halobatodes. He concludes that the region between the eastern part of the Indian Ocean and the West Pacific is the birthplace of the genus Halobates, whence it has spread to other parts of the world, Halobatodes being one of its derivatives.

The monograph of the anatomy of Peripatus, begun by the late Professor Balfour, has already been published under the editorship of Moseley and Sedgwick, the latter of whom is now continuing the subject by the use of material collected by himself at the Cape of Good Hope last summer. It is questionable, therefore, whether this will form part of the Challenger series.

Dr. P. P. C. Hoek of Leyden has printed his report upon the Pycnogonida (vol. iii., 167 p., 21 pl.), which, in addition to discussing the 41 species dredged by the Challenger and the Knight Errant, 33 of which were new, contains a critical review of the genera and species, 129 in number already known to science, in which frequent complimentary references are made to the work of our countryman, E. B. Wilson, upon the same group. The most important generalizations obtained are: 1. That those genera which range most widely geographically are also those which range most widely in depth; 2. That, though there are deep-sea species, deep-sea genera do not appear to exist. The author admits his inability to show any definite influence of deep-water habitat upon the form and structure of the animals under consideration.

Dr. Hoek's report on the Cirripedia (vol. viii., 189 p., 13 pl.) appears to be a very carefully executed and scholarly essay. Its usefulness is greatly enhanced by a well-made index, and an introduction in which the history of the group, and its literature since the

publication of Darwin's monographs, are carefully and critically summarized. Darwin knew 147 species of cirripeds; 18 were added by his successors; while, in the present report, 59 are described, together with 1 new generic type; 78 species, in all, having been collected. The percentage of new material in this group was therefore unusually great.

Out of 34 genera known, 28 have never been observed at a depth greater than 150 fathoms. It is shown that there are no deep-sea genera; for, even of the two genera ranging lowest in depth, species are known from shallow water. Dr. Hoek's discussion of these two genera, in which he shows that their occurrence in great depths coincides in a striking manner with their paleontological history, is very suggestive; as is also his statement, that, in the case of Scalpellum, the deep-sea rather than the shallow-water forms have preserved the character of the oldest fossil species of the genus, while, in the case of Pollicipes, the more archaic types are found in shallow water. The author also points out the fact, that, while the deep-sea genera have a world-wide range, the deep-sea species ordinarily have only a very limited distribution.

A most laborious paper is that upon the Ostracoda (vol. i., 184 p., 43 pl.), by Prof. G. Stewardson Brady of Sunderland, with its almost endless array of figures, at least 2,000 in number. The paper is almost entirely descriptive; families, genera, and species, old as well as new, being fully characterized. Out of the 220 species obtained, 143 were new; and only 15 of the entire number catalogued owe their names to other authority than the author. The deductions concerning geographical distribution are, of course, very interesting. It is shown that Ostracoda occur very sparingly in the oceanic abysses: only 19 species were found at depths below 1,500 fathoms, and only 52 below 500. The materials for a study of the horizontal distribution of the group were not very extensive; and it is evident that there is still an immense amount to be done in the study of Ostracoda in all parts of the world, particularly in the shallow waters, which the Challenger rarely touched.

The report upon the Copepoda, by the same author (vol. viii., 142 p., 55 pl.), is also purely descriptive: 106 species are enumerated, of which 47 are described as new, 10 new generic types being defined. It is an interesting evidence of the exhaustive character of Dana's work while connected with the Wilkes exploring expedition, to note, that, out of the 90 species of free-swimming Copepoda collected, 30 were described by him, and that sixty per cent of the previously described forms in the list bear his name. Professor Brady's drawings and descriptions are admirably executed. The lack of an index to text and plates is, however, much to be regretted. The Challenger Copepoda were almost without exception obtained by surface towing. The only undoubted deep-sea species was Pontostratiotes abyssicola, of which a single specimen was obtained at 2,200 fathoms.

Many of the reports on crustaceans are yet to appear, — discussions of the brachyurans, by E. J. Miers; the anomurans, by Professor Jules Barrois, director of the zoölogical laboratory at Villefranche; the macrurans, by C. Spence Bate; the Amphipoda, by the Rev. T. R. R. Stebbing; and the Cumacea, Schizopoda, Stomatopoda, and Isopoda, by authorities not yet named.

Nothing whatever has been printed upon the Vermes as yet. The annelids are in the hands of Dr. W. C. McIntosh. Professor Ray Lankester has the gephyreans; and Dr. Ludwig Graff, the Myzostomidae. The assignment of the Chaetognatha to Dr. Oscar Hertwig was announced in 1880; but this group has been omitted in later lists — without explanation, however, and it is to be hoped unintentionally.

The report upon the Holothurioidea, by Dr. Hjalmar Théel of Upsala (vol. iv., 176 p., 46 pl.), is one of the most interesting of the special descriptive papers; since the deep-sea holothurians are shown to constitute a group by themselves, specially characteristic of the abyssal fauna, and very different from the littoral forms hitherto known. This group, which is placed by the author in a new order, Elasipoda, is believed by him to have in certain respects attained a higher development than all the other echinoderms, — "a development which is gradually approaching the higher classes of animals." Previous to the publication of this report, only three animals of this group were known; these having been brought in by the Swedish and Norwegian dredging expeditions of 1875, 1876, and 1878. There are here described 52 species and 3 varieties, distributed into 19 genera. Of this entire number, only 4 are found at depths less than 500 fathoms, as many more from 500 to 1,000, the remainder from 1,000 to 2,900 fathoms. "Thus we learn that the Elasipoda abound over the floor of the ocean at great depths, and that the number of species and of individuals is greatly reduced shorewards."

G. Brown Goode.

THE CENSUS REPORT OF 1880.

It is now the middle of 1884, — four years since the date of the last census of the United States; yet the volumes of that census are not all published by the government. Eight volumes have appeared, besides the bulletins issued during the years 1881 and 1882: viz., two of the 'Compendium,' containing 1,850 octavo pages, and published early in 1883; and six of the quarto volumes, containing from 850 to 1,300 pages each, in which are given the more extended tabulations, and the general treatises on population, agriculture, manufactures, transportation, cotton-production, etc. The number of these quarto volumes is not positively stated by the census officials, but will probably be twenty. We may consider the first six, however (of which the first four came out in 1883, and the other two in 1884), without waiting until the series is complete, which may not be until two years hence. The important volume, which is to contain the 'social statistics' of pauperism, insanity, crime, etc., is not yet in the printers' hands; and the tables and general treatises on these topics are still subject to alteration by those who are editing them. The same is true of the mortality statistics and many others; and so liable is the work of editing these tables to be delayed, that it is quite impossible now to say when the final volume will appear.

There are two ways of looking at a great statistical work of this sort, intended to show the economic and social relations of fifty millions of people, scattered over millions of square miles, in every form of civilization and every mode of living. One way is to consider what has been done to exhibit these statistics, and to be thankful for that; which must, of necessity, be an immense labor, and exposed to many minor inaccuracies. The other way is to set up a standard of performance in work of this kind, and to criticise what falls short of this standard. The latter would be the true method, if statistical science had yet advanced far enough to enable so great a census as ours was in 1880 to be taken with accuracy, and reported by persons who understand what they are to do, and how to do it in the same thorough manner in which trained investigators in some special science proceed. But there is as yet no example of census-work done in this manner, and we must not look for it in the work before us. A certain degree of accuracy has been attained, though less, we believe, in most instances, than the specialists at the head of each branch of inquiry suppose. But the explanations and cautions and qualifications which they put forth in each of these census volumes, in regard to the tabulations that present their particular topic, will soon convince the casual reader that he must use these statistics with much circumspection, or they will lead him astray There is hardly a point, for example, on which the more elaborate work of this tenth census does not bring out the faults and defects of the earlier ones, and show that even the last preceding census, that of 1870, which was taken under the same superintendent (President Walker of the Institute of technology), was grossly and amusingly wrong in important particulars.

It is therefore evident at once, that to compare the results in 1880 with those in 1870, 1860, etc., in order to exhibit the growth of the United States, is only possible in a few general respects, if any reasonable exactness in the comparison is insisted upon. Sometimes this comes from the nature of things, and not always from the errors of the enumerators or tabulators in previous decades. For example: the value of the dollar (by which all products, debts, revenues, property, etc., are measured) was so different in 1870 from what it had been in 1860, and again from what it became in 1880, that it is not possible to make these pecuniary comparisons without great risk of mistake. To take the premium on gold in 1870 as the measure of depreciation for our currency, though this is all we can do, is well known, by those who noted prices and values then as compared with ten years before or since, to be extremely fallacious. The rubber yardstick of the imaginary tradesman, which was sometimes four feet long and sometimes only two, is a fair type of the fluctuating and elastic currency by which we have had to measure values since the civil war.

But the fallibility of the men who make up the census schedules, who take the count of men, animals, crops, acres, houses, farms, mills, etc., is the chief source of inaccuracy in any census. It is not possible to foresee exactly what questions ought to be asked, or where to draw the line between attainable and inaccessible facts. The questioner may defeat his own purpose, not only by the form, but by the multiplicity, of his requirements. Nature quickly sets a limit to the power of answering the census inquiries accurately in case of the average citizen or his wife. To go beyond that limit is to invite error and blunder, as the expert tabulator of the answers well knows: he therefore undertakes by his tabulation to amend the defects of the return. But this, also,

is only possible to a limited extent; and the enlightened efforts of the expert may end in aggravating the blunders of the enumerator. His own opinion or prejudice may come in, and so warp the poor facts already twisted out of shape by the clumsy reporter of them, that they finally bear no likeness to the situation they ought to portray. A permanent statistical bureau, collecting its facts from year to year, and correcting the mistakes of one year by the better information of the next, is far less likely to err in this respect than an organization which works, like our national census bureau, only at intervals of ten years. Though the latter may, and of late years does, extend its labors well over the whole period from one ten-years' point to another, it still lacks the useful correction which annual returns inevitably supply.

All things considered, the eight volumes before us are excellent, and indicate that the whole series, when completed, will far surpass, not only the work of any previous decade in this country, but the published results of any similar census in the world. The plan of President Walker was an ambitious one, his selection of experts and subordinates was mainly good, and the time allowed for them to complete their tasks has been ample. Unfortunately, the cost of so great an enterprise was not well understood; and the needful appropriations of money have not been made, or have been so delayed as to impede the work. The undertaking also suffered from its own vastness, and much of that which was hoped for was found unattainable. The important subject of pauperism, for example, — the correlative to our unexampled growth in material wealth, — receives inadequate treatment in the 'Compendium,' and cannot be so exhibited in the quarto volume as to do it justice. Mr. Wines, who has charge of this topic, has given up in despair the effort to collect statistics of out-door relief, and only reports on the almshouse expenditure, and number of inmates. This is, in fact, to omit more than half the material belonging to the subject, and that portion, too, which best exhibits the growth of pauperism from year to year. In other divisions of the work a similar class of omissions may occur, in consequence of which the results will appear in some respects more defective than those of the last census. But in fact, and on the whole, they are much more complete; and the volumes now issued, with those which are to appear, will furnish material to economic and scientific students for years to come. The more they use them, the better will they appreciate the foresight, labor, and research of the men who compiled them, although they will also perceive more clearly how defective the most perfect statistics are foreordained to be.

GEOLOGY OF THE SUSQUEHANNA RIVER REGION.

Second geological survey of Pennsylvania: report of progress G^7. The geology of the Susquehanna River region in the six counties of Wyoming, Lackawanna, Luzerne, Columbia, Montour, and Northumberland. By I. C. WHITE. With a colored geological map in two sheets, and 31 page plates in the text. Harrisburg, 1883. 30 + 464 p. 8°.

THE region to which this report relates embraces nearly two thousand square miles of the Devonian and Silurian rocks lying north and west of the great anthracite-coal basins, along the north branch of the Susquehanna River. Although there are some small outliers of the true coal-measures in this district, Professor White has referred to these only incidentally; his report beginning at the base of the Pottsville conglomerate (millstone grit) No. xii., and extending down to the oldest formation exposed, which is the Medina No. iv.

The volume begins with a long prefatory letter by Professor Lesley, director of the survey. This is essentially a somewhat critical summary of the more interesting features of Professor White's report, which embraces two distinct portions; the first third of the volume being a comprehensive account of the geology of the entire district, and comprising nearly every thing of general interest, while the remainder of the work is devoted to a detailed report by townships on each of the six counties.

A brief account of the drainage and topography is followed by a description of the interesting glacial phenomena. The great terminal moraine crosses Carbon, Luzerne, and Columbia counties in a general north-westerly direction, dividing the region into a north-east glaciated portion and a south-west unglaciated portion. Back of the moraine is the mantle of unmodified drift, derived entirely from the local rocks. In front of the moraine, or to the south and west, the whole country is covered, up to a height of seven hundred and fifty to eight hundred feet above tide, with a stratified deposit of modified drift. According to Professor White, this deposit was spread by the gigantic rivers resulting from the melting of the ice-sheet; but Professor Lesley finds it necessary to suppose a subsidence of the land,

that permitted the sea to wash the terminal moraine, and cover all points less than eight hundred or a thousand feet above tide. Out of the modified and unmodified drift the modern rivers have carved their channels, leaving a series of well-marked terraces, the highest of which are now two hundred feet above the streams.

But in the northern or Wilkes-Barre coal-basin, the Susquehanna and its tributaries are still fifty to a hundred and eighty-five feet above their pre-glacial beds for a distance of at least twenty-five miles; and these buried valleys are of unusual interest, because at Bloomsburg, Sunbury, and Selinsgrove, points on the Susquehanna thirty to seventy miles below Wilkes-Barre, the rocky bed of the river is a hundred and ten, ninety, and seventy feet respectively higher than the buried channel at Wilkes-Barre.

The geological structure of this district is typically Appalachian, a north-west and south-east section including ten principal overlapping flexures of the strata, and the synclinals holding the anthracite-coal fields.

Professor White believes there is a transition series between the Pocono sandstone No. x. and the Catskill No. ix., and another between the Catskill and the Chemung No. viii.

The paleontology of this report presents several striking anomalies; various Devonian and Silurian types, including some of those regarded as most characteristic of their respective horizons, occurring here in associations, and following each other vertically, in an order unknown elsewhere. Professor Lesley suggests that this apparent confusion may be due, in part, to incorrect determinations of the forms. But some of the confusion is real; for Halysytes catenulata, a coral which no one could mistake, occurs very abundantly at one locality in the Stormville limestone, which belongs near the middle of the lower Helderberg, although this form was never before found above the Niagara.

Like most of the Pennsylvania reports, this volume is abundantly indexed; there being six different indexes, covering fifty-four pages.

NOTES AND NEWS.

A SHORT time since, we referred to the call of the Peabody museum of American archaeology for funds to enable the museum to continue its important and thorough explorations in Ohio. So far the work has been continued without interruption, thanks to the persons whose subscriptions are here acknowledged: Mr. John C. Phillips, Boston, $200; Hon. Stephen Salisbury, Worcester, $100; Hon. Robert C. Winthrop, Boston, $50; Mr. H. A. Homes, Albany, N.Y., $5; Mr. A. H. Thompson, Topeka, Kan., $5; Mr. A. E. Douglass, New York, N.Y., $47; Mr. William B. Weedon, Providence, R.I., $50; Mrs. Esther Herrman, New York, N.Y., $50: total, $507.

— The French association for the advancement of science has appointed two delegates to attend the Philadelphia meeting of the American association, — Professor Joubert, professor of physics, and general secretary of the French society of physics; Professor Silva, professor of chemistry at the Municipal school of physics and industrial chemistry. This is of interest as promoting the formation of an international association.

— Before the section of economic science and statistics of the American association, papers are announced on the following subjects: A study of cotton fibres, their value, etc., illustrated by photo-micrographs; The economics in deaf-mute instruction; Explanation of instruments used to determine the power to move trains, and also of instruments for the inspection of railroad-tracks; The apprenticeship question and industrial schools; The value of photo-micrographs of wood-fibres, illustrated with sections of thirty different woods; The use of graphics in statistics; Exhibitions, national and international, considered as economic forces; Theory and economy of the American system of patents; The allotment of lands to Indians, illustrated by experience with the Omaha tribes; The public and the professions, 1870–80; Statistics and organization of the classified public service in the United States; Some general results of the census of crime and misfortune in the United States; The economic element in the problem of manual training. (Several papers are expected on important topics.)

— We are informed by a private letter that three of the younger mathematicians of Germany, all men of mark, are expecting to attend the meeting of the British association in Montreal, and are planning afterwards to visit the United States. Reference is made to Messrs. Lindemann of Königsberg, Dyck of Munich, and Wedekind of Carlsruhe, all of them professors ordinarii in their respective places.

— *Nature* states, that, at the request of the council of the British association, Admiral Sir Erasmus Ommanney, C.B., F.R.S., has consented to act as treasurer during the meeting at Montreal, Canada. It further announces that Prof. W. G. Adams of King's college will be unable to give the Friday evening lecture at Montreal, and that Prof. O. J. Lodge will take his place. The subject of Professor Lodge's lecture will be 'Dust.'

— The Seth Thomas clock-company has undertaken, under the advice and guidance of Dr. L. Waldo, the construction of clocks of a high grade of excellence for scientific purposes, which they propose to call clocks of precision. They have already made considerable progress as to the best form of pendulum suspension, and dimensions of the steel-jar mercurial pendulum (which is filled *in vacuo* by a new

process): and, as soon as the small physical laboratory they are now building for this purpose is completed, they propose to investigate some of the questions which make good clock-making such a difficult art; such as, the permanency of length of pendulum-rods of various materials, the effect of air mechanically contained in the ordinary mercurial pendulums, the effect of mercuric oxide and other impurities of the mercury, and the effect of temperature changes on various forms of pendulum suspension.

This is another instance of the tendency shown by American artisans to avail themselves of the most recent knowledge to be derived from scientific research. Some time since, we noticed that the Pratt & Whitney company of Hartford were spending many thousands of dollars in their efforts to produce screws and other measuring-engines which would accurately correspond to the established yard and metre. In this work they availed themselves of the assistance of Professor Rogers of Cambridge; and the results they attained must be gratifying to every student of physical science interested in having accurate screws and gauges for use independently, or in connection with other pieces of apparatus.

— The efforts of the committee of the Franklin institute to secure a valuable collection of books on electricity for the electrical exhibition are meeting with considerable success. Already the collection numbers about three thousand titles, and is constantly increasing. As is well known, the Pennsylvania railroad company has placed its old passenger-station at the disposal of the managers of the exhibition to furnish additional space.

— The Chesapeake zoölogical laboratory, which is the name under which the marine zoölogical station of the Johns Hopkins university has been maintained during the last six years, is stationed this year at Beaufort, N.C., — a site which has been proved during three previous seasons, from 1880 to 1882, to be most favorable for zoölogical researches. Dr. W. K. Brooks, the director of the laboratory, has been prevented by long-continued ill health from assuming his usual responsibilities, though he has hoped to join the party for a time. His place as chief of the party has been taken for the season, at the request of the university, by H. W. Conn, Ph.D., who received not long ago one of the Walker prizes from the Boston society of natural history, and who has recently been appointed to a position in the Wesleyan university at Middletown. Besides Dr. Conn, there are nine investigators at work; among them, W. Bateson of St. John's college (Cambridge, Eng.), H. H. Donaldson (A.B., Yale), E. A. Andrews (A.B., Yale), I. Nelson (S.B., Univ. Wisc.), H. L. Osborn (A.B., Wesl.), and H. F. Nachtrieb (S.B., Univ. Minn.). Others were expected to join the company. Private letters from Beaufort give indications that the summer's work will be fruitful in good results.

— The Greely relief squadron, with the survivors on board, arrived at Portsmouth on Friday, Aug. 1, and a reception with a grand parade was given to them Monday, Aug. 4. The remains of those who perished have been sent to New York for burial.

— North-western North America contains so many different linguistic stocks, and these are split up into such a large number of languages and dialects, that any contribution to the supply of vocabularies from this region is important. A pamphlet of a hundred and twenty-seven pages, just issued by the geological survey of Canada, contains vocabularies of "one or more dialects of every Indian language spoken on the Pacific slope from the Columbia River north to the Chilkat River, and beyond, in Alaska, and from the outermost seaboard to the main continental divide in the Rocky Mountains," and is therefore a most welcome addition to the working-material of the linguistic scholar. The vocabularies result from the joint labors of Messrs. N. Fraser Tolmie and George M. Dawson, whose names are a sufficient guaranty for the general accuracy of the work. The vocabularies number more than thirty, and are classed by the authors under no fewer than fourteen distinct stocks, — a number which it is probable will require to be reduced. Few scholars, at least, will be willing to admit Tsheheilis as a stock distinct from Selish, of which latter it is usually considered to be the westernmost division, nor to consider Bilhoola, Kawitshin, and Niskwalli distinct from Selish. The value of the volume is greatly enhanced by a map colored to show the distribution of the Indian tribes of British Columbia. The linguistic stocks, the distribution of which within the above area is shown, are the Tlinkit, Tshimsian, Haida, Tinnē, Kwakiol, Bilhoola, Aht, Kawitshin, Niskwalli or Skwalliamish, Selish, and Kootenuha. The work is a substantial addition to the linguistic history of the area to which it pertains.

— The bibliography of Ptolemy's geography, which Mr. Justin Winsor has been printing by instalments in the Harvard university *Bulletin*, has been issued separately, in advance of its completion in the *Bulletin*, and forms an interesting contribution (forty-two pages) to historical geography. It is particularly valuable for the information it gives regarding the early cartography of America, and the ante-Columbian views of the ocean west of Europe. Much collateral matter serves to elucidate the subject. The name 'America' appears for the first time on a Ptolemaic map in 1522; but reasons are given for believing that it occurred in print or in manuscript as early as 1513-15. It appears that copies of the 1478 edition have been sold at eighty, ninety, and a hundred pounds.

— According to *Nature*, Pasteur's experiments with the virus of hydrophobia are going on with unbroken success. He has thus far experimented on fifty-seven dogs, — nineteen of them mad, and thirty-eight bitten by them under uniform conditions. Out of these thirty-eight, half had been previously inoculated, the other half not. The latter, without a single exception, died with unmistakable signs of hydrophobia, whereas the nineteen others are about, and as well as ever. They will be watched for a year by veterinary doctors to see whether the inoculation holds good permanently or only temporarily.

— A meeting was held on July 1, in the lecture-

room of the British museum, for the purpose of conferring as to the advisability of adopting the method of trinomial nomenclature now coming into use among American zoölogists. The meeting was held on the occasion of the visit to England of Dr. Elliott Coues, a prominent advocate of the system in the United States. Dr. R. Bowdler Sharpe read a paper on a series of sub-species of goshawk, differing slightly in character, and coming from South Africa, Senegambia, Turkey, Asia Minor, India, Ceylon, and Burmah. Other cases he cited were those of Corone, in which the species differ only in size. These cases inclined Mr. Sharpe to view Dr. Coues's proposals with favor. He was followed by Mr. Seebohm, who stated his belief that the present system of binomial nomenclature had retarded our recognition of the fact of the existence of sub-species. Selecting the forms of nut-hatches, he illustrated the method by which he would convert Dr. Coues's empirical into a more logical system. Dr. Coues was very heartily received. He said he recognized that nomenclature was a necessary evil. Since the establishment of the binomial system by Linné, there had been an absolute revolution in our ideas of what species were. "We now recognize that there are no such things as species, and that forms are so intimately related, that, did we know all, there would be an unbroken series;" and Dr. Coues instanced the American woodpecker in proof of this. Other speakers followed; the main objections to the new system being the fear of endless introduction of new names, and the temptation to those who already refined too much. In summing up, Professor Flower said that some fresh system of nomenclature would be inevitable, but what system remained to be seen.

— The distinguished mathematician, Dr. George Salmon, regius professor of divinity in Trinity college, Dublin, has been elected a corresponding member of the Académie des sciences, Institut de France, to succeed Dr. William Spottiswoode, the late president of the Royal society.

— *Nature* announces the death of the venerable Abbé Moigno at the age of eighty-one years. The name of the abbé has been long known in connection with French science, and more especially as the founder, and till quite recently the editor, of *Les mondes*.

— The State natural-history society of Illinois held its annual meeting at Peoria, at the National hotel, commencing July 7. Among the papers presented were the following: The president's address, Dr. Julius S. Taylor; Illinois forestry, T. J. Burrill; Developments in the Streator coal-field, Edwin Evans; Mastodon and other remains of the loess and drift clays, and their relation to the climatology and geology of the deposits, Dakota mounds, Ancient pictographic records on the rocks in the vicinity of the Missouri River, Experiments with a copper-head serpent, William McAdams; Marine algae, Rise of sap in trees, Corn fungi, A. B. Seymour; Silk-culture, J. E. Armstrong; Phytoptus galls on the leaves of Nyssa multiflora, H. Garman; Artificial production and propagation of insect diseases, S. A. Forbes; Location of sound by the ear, J. B. Taylor; Life-history of Prionyxystus robiniae Peck, Parasites of Apatura clyton, Preliminary stages of Papilio cresphontes, A. H. Mundt; Higher cryptogams, Mrs. Dr. Griffith; Instruction in zoölogy, B. P. Colton; Zoölogy in country schools, F. A. Houghton; Introduction of fishes into new waters by natural means, D. B. Wier; Embryology of the buccal mucous membrane, Will X. Sudduth.

— At the March meeting of the Royal astronomical society, Dr. David Gill, her majesty's astronomer at the Cape, stated that he had prepared a scheme for the investigation of the parallax of stars, but that the carrying it out, in so far as the southern hemisphere was concerned, depended on the generosity of the lords commissioners of the admiralty in providing him with a heliometer necessary for the purpose. On the 13th of June he had an interview with the authorities of her majesty's treasury, and was permitted to state to the society, at its meeting on the evening of the same day, that they would not be wanting in the necessary generosity. It will be remembered that the co-operation of Dr. Elkin, working with the large heliometer of the Yale college observatory, is included in this plan.

— The first De Morgan memorial medal has been awarded by the London mathematical society to Professor Arthur Cayley, for his contributions to the modern higher algebra and other branches of mathematics. The presentation of the medal will take place at the annual meeting of the society, in November next.

— The way of connecting electric-light circuits, which is represented in fig. 1, has been introduced by

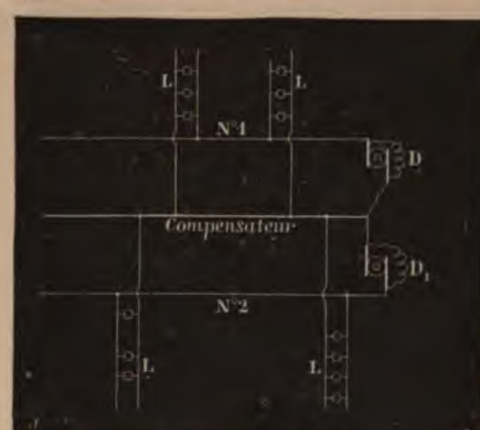


FIG. 1.

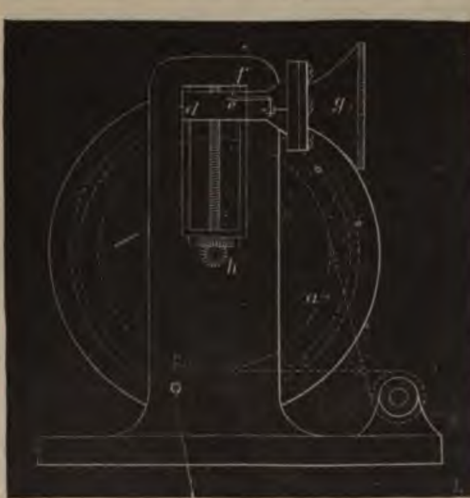
Dr. Hopkinson and Mr. Edison. Two dynamos, D, D, are connected in series to the principal lines, No. 1 and No. 2; and a third conductor, called the 'compensator,' is introduced to serve as the return circuit. The lamps L and L are placed between the main lines and the compensating line. It is claimed that this arrangement diminishes the weight of copper

necessary in the wires by sixty per cent; but this figure is probably too high. If the electromotive force of the dynamo is too high for the lamps, a third wire between the two principal conductors may be used, and the lamps inserted between this and the two principal conductors.

Fig. 2.

Fig. 2 represents an arrangement invented by Mr. J. S. Beesman: it is composed of two dynamos, connected as shown, the two circuits of the dynamos being joined crosswise by the lamps. It will be seen that this arrangement permits each lamp to have the same difference of potential between its extremities, because, as each lamp is nearer one of the dynamos, it is the more distant from the other. If the lines are considered as rails, or other conductors on an electric railway, the speed will be the same at all points of the line; for the difference of potentials between the conductors will be constant: consequently, if several trains of the same weight run over the same line, they will not strain to go by each other.

— Among recent German patents is one issued to D. French St. George of London, for a novel form of phonograph. The cut shows a round photographic plate *a*, upon which a ray of light falls through the opening at *e*. A slide over this opening is connected with the vibrating plate in the mouth-



piece *g* in such a way, that, with the vibrations of the plate, the size of the opening is varied. The result is, that on the photographic disk, which is kept in rotation at a constant rate, there is produced, after development, a dark circle of varying width. In order to reproduce the tones of the voice, a ray of light is sent through this photographic image upon a selenium transmitter of the form invented by A. Graham Bell, and used in his radiophone.

— The Berlin African association despatched an expedition to the Kongo during July, of which Lieut. Schulz is to be the leader. News has been received of the two travellers for this association, — Dr. Richard Böhm, and the engineer, P. Reichard, — of the date of last August. They had crossed Lake Tanganyika with the Belgian agent at Karema, Lieut. Storms, to Qua Mpara, and started across unexplored country for Lake Moeso. The *Illustrirte zeitung* states that Dr. Böhm is to succeed Lieut. Storms in command at Karema. The International African association has founded thirty-two stations in addition to Leopoldville. Ten of these are on the Niadi-Kwilee, twenty on the Congo, and two on the coast. During his last journey, Stanley acquired a considerable length of the river-bank. By means of the steamers and the new roads round the rapids, the journey to Stanley Pool can now be made in fourteen days. Col. Winton has taken the command between Vivi and Stanley Pool.

— M. J. B. Morot, lately deceased, left to the Société de géographie a sum of two thousand francs, the interest of which is to form an annual prize for the French navigator who shall approach nearest to the north pole during the year; or, in default of a suitable receiver, the prize may, at the discretion of the society, accumulate for two years. In the absence of an arctic navigator, it may be awarded to the discoverer of an unknown island or country.

— Capt. Sörensen has determined that the northern point of Europe is not Cape North, as usually assumed, but a promontory called Knivskjoerodde, about ten minutes of longitude west from Cape North, and reaching nearly a thousand metres in a northerly direction beyond the extremity of Cape North.

— Three important memoirs on the geology and geography of eastern Europe have lately appeared. The first, by Dokuchaeff, treats of the distribution of the black loam (chernoi zemlia) of Russia, famed for its fertility. Another, by Paul Veniukoff, considers the distribution of the Devonian rocks of Russia. The third, by Vitikin, discusses the formation of the valleys of central Russia. These, according to the author, are due to a gradual elevation of the land, which left the edges of a shallow sea transformed into plains, across which brooks made their way, cutting out ravines and channels, growing in importance and volume as the area of land enlarged, and finally becoming rivers. There was no lake-period, as in the Baltic region. With few exceptions, the lakes of central Russia are ancient river-beds, cut off by changes in the course of the stream. Behr's law is exemplified in the valleys of the principal streams, which, like the Volga, Viatka, and others, have a general parallelism with the meridian.

SCIENCE.

FRIDAY, AUGUST 15, 1884.

COMMENT AND CRITICISM.

A MARKED feature of recent scientific work is the tendency to international co-operation. Problems too large to be undertaken by a single institution, or even by one nation, are thus successfully solved. Two examples suggest themselves. The first of these is the largest piece of astronomical work yet undertaken. Since 1870 a dozen observatories have been actively engaged in preparing a catalogue of about a hundred thousand stars in the northern hemisphere, a part of the sky being assigned to each observatory. The Greely expedition recalls the second example. This was one of a dozen expeditions fitted out by various governments to secure simultaneous meteorological observations for one year at different points within the arctic circle. Other examples might be added, all tending to show that co-operation is likely to yield results of lasting value.

We have on several occasions called attention editorially, or through our contributors, to the advantages likely to follow the organization of an international scientific association properly formed; and the responses which have come to a recent appeal are to-day referred to in our notes. Besides the inspiration the individual members would gain from attendance at its sessions, such a society would inspire great confidence in the work that it might undertake. It would then become comparatively easy to secure proper means for investigation. Observers, too, would be much more willing to aid in a research in which there was little danger of needless duplication.

A CORRESPONDENT calls our attention to the omission of the Henry Draper medal in our brief list of honors founded in this country for scientific research. Both this and the Watson medal were overlooked; as we were under the impression that the gifts of Mrs. Draper and Professor Watson were wholly in aid of, rather than as rewards for, research. This last is the case in part with the Watson fund, the income of which is directed to be expended 'for the promotion of astronomical science.' But in making the National academy of sciences his residuary legatee, Mr. Watson also provided that a gold medal of the value of one hundred dollars, with a further gratuity of one hundred dollars, should be given "from time to time to the person in any country who shall make any astronomical discovery, or produce any astronomical work, worthy of reward, and contributing to our science." The fund is of recent date, and no award of the medal has yet been made; but a part of the expenses of the eclipse expedition to Caroline Island was paid from the fund.

The fund given by Mrs. Draper to the national academy, to commemorate one of its members, the late Dr. Henry Draper, is also very recent, and no award has yet been made. A gold medal of the value of two hundred dollars is to be awarded, not oftener than every two years, 'to any person in the United States of America, or elsewhere' (with preference, other things being equal, to an American), 'who shall make an original investigation in astronomical physics' meriting such an award. This award, like the Lawrence Smith medal, can be given only for investigations made or published since the last preceding award.

One is tempted to speculate on the comparative value of funds given in direct aid of scientific research, and of medals or gratuities rewarding successful discovery or searching investigation. The former, as the endowment of research, must surely produce the more immediate practical results; while the latter signalize the victories of science, and, when properly administered, direct public attention to what is of true value. But in the probable

extension of such foundations as the latter in this generous country, does there not lurk a possible danger, — a danger that their bestowal will fall into hands incapable of proper administration? If any one think this danger remote, let him reflect on the ill-judged selection of recipients for honorary degrees in many of our best universities and colleges. Let such foundations remain, as now, in the hands of those whose position has been gained solely by research, and the danger vanishes.

THE standard of light adopted by the Paris electrical conference last April is the amount of light emitted by a square centimetre of melted surface of platinum at the point of solidification. It was believed that advantage could thus be taken of a physical constant (namely, the melting-point of platinum) upon which could be based all our present changing and unsatisfactory photometric standards. The adoption of this standard has been much criticised, for it does not seem to lend itself easily to actual photometric tests. Werner Siemens proposes that a piece of platinum foil should be enclosed in a cavity provided with a conical opening 0.1 of a square centimetre; this piece of platinum to make part of an electrical circuit, the current in which can be so regulated that a comparison with any light can be made at the moment of fusion. The temperatures of solidification and fusion of platinum do not differ sensibly from each other, and Siemens believes that the error introduced by taking the temperature of fusion instead of that of solidification would be small. The use of an electrical current to produce fusion has certain advantages, for the time of fusion can evidently be deferred until the proper moment. Preliminary experiments have shown that the light emitted from an opening 0.1 of a square centimetre in section by Siemens's method is equivalent to nearly one and a half standard English candles.

Although the standard adopted by the Paris conference seems to be based upon the unalterable laws of matter, it does not seem as if it would ever be practically adopted. Some form of the modern incandescent electric light, it seems to us, would afford a much better prospect of a standard light. It is difficult to maintain the steadiness of such a light for photometric purposes; but this does not seem impossible to accomplish. It is evident, that, if we could maintain an electrical current constant through a platinum wire or carbon filament in a suitable medium, we should have the means of reproducing the same amount of heat, and therefore light, from the same area. Unfortunately, carbon changes in resistance at the point of incandescence; and the resistance of platinum is not invariable under repeated heating and cooling in a comparative vacuum. An exhaustive investigation of the peculiarities of platinum or of iridium, under the effect of incandescence produced by the electrical current, would seem to be desirable before the French standard is accepted as a finality.

LETTER TO THE EDITOR.

Tornado predictions.

IN an article on 'Tornado predictions,' published in the July number of the *American meteorological journal*, a table of verifications is given, in which the average of successful predictions for several months is from ninety-six to ninety-eight per cent.

An examination of the table shows that this remarkably high percentage of verification is largely made up, *not* of successful predictions of tornadoes, but of successful predictions of no tornadoes. In justification of this method of verification, the writer says, "It requires as much and often more study to say that no tornadoes will occur, as to make the prediction that conditions are favorable for their development." If this explanation be accepted as satisfactory, what do the verifications signify?

A little consideration will show that the *absolute* value of these figures gives no basis from which to judge of the real success of the tornado predictions. The averages of ninety-six and ninety-eight per cent are mainly functions of the non-tornado days, with but slight modifications for the success or failure of the prediction of actual tornadoes. An ignoramus in tornado studies can predict no tornadoes for a whole season, and obtain an average of fully ninety-five per cent. The value of the expert work must, therefore, be measured by the excess which is obtained over the man who knows nothing of the subject. This is the only way to determine any significance in the method of verification above described. The excess is but one or two per cent, and poorly exhibits the present stage of progress in tornado studies. The injustice which is done is to be found in the method of verification adopted. In ascertaining the value of tornado or any other special storm predictions, the consideration of days on which no storms occur, and none are predicted, is entirely beside the question.

If the writer of 'Tornado predictions' will give the verifications obtained from positive predictions, and

the occurrence of actual tornadoes, his measure of success will be directly apparent. G.

THE NATIONAL CONFERENCE OF ELECTRICIANS.

THE president of the United States, in pursuance of a special provision of congress, has appointed a scientific commission, the composition of which we gave in No. 78, of which Professor Rowland is chairman, and which may, in the name of the United-States government, conduct a national conference of electricians in Philadelphia in the autumn of 1884. The law creating the commission is as follows: "That the president of the United States be, and is hereby, authorized to appoint a scientific commission which may, in the name of the United-States government, conduct a national conference of electricians in Philadelphia in the autumn of 1884; that said commission may invite scientific men, native and foreign, to participate in the conference, and may, in general, determine the scope and character of its work; that the sum of seven thousand five hundred dollars be appropriated to meet the expenses of the commission in conducting the conference and investigations, and to meet the expenses of preparing reports of the same, *provided* that the whole amount of the expenses incurred by said commission shall not exceed the said sum of seven thousand five hundred dollars, and the members of said commission shall not receive any compensation for services." It is left to the discretion of the commission to invite foreign scientific men to join in the labors of the conference; and the United-States government does not dictate in regard to the topics which are to be treated in the conferences, further than to require that the first meeting shall be held as early as Aug. 7, 1884. In the letter to each member of the commission, apprising him of his appointment, Secretary Frelinghuysen writes, "It is hardly necessary to observe that this commission, appointed for high scientific purposes, will not permit its influences to be exerted in behalf of any person or company, manufacturers of electrical apparatus or machines."

The *raison d'être* of this commission is the conjunction of the electrical exposition in Philadelphia with the meeting of the American association of science in the same place, and the meeting of the British association in Montreal. It is hoped that a number of foreign scientific men may be induced to deliberate with the American commission upon more or less international electrical questions. It is thought by some that there is hardly need of another conference of electricians. The French conference has lately adjourned. Lord Rayleigh has made an exhaustive determination of the ohm. A standard of light has been adopted which is the best that present experience indicates. The meteorological directions of electrical science need time, and not conferences, for their development; and the protection of international cables and international telegraphic relations was fully considered in the French conference. In answer to this view, it must be pointed out that the mere assemblage of those most interested and practised in any department of science is necessary in the present state of scientific research. There are no 'gentle hermits' in the subject of electricity; and no one can hope to advance the subject by working in a remote lighthouse or on a desert island. There may be Victor Hugos in poetry and fiction, but not in electricity.

It is possible that American science may enlighten foreign science, even on such trite subjects as the ohm and the standard of light. There is, moreover, the adoption of the electric light by the American lighthouses, and a report upon the uses of electricity in connection with torpedo warfare, — a subject, when it is considered that torpedoes constitute our principal means of harbor defence, of especial interest in the coming presidential election. The imagination needs only a slight stimulation to perceive that the government can reasonably expect as great a return for the sum of seven thousand five hundred dollars invested in an electrical conference, as it can hope to have from the same sum expended in improving the harbor of Podunk.

THE HARVARD PHYSIOLOGICAL LABORATORY.

THE physiological laboratory of the medical school of Harvard university presents some peculiarities of arrangement and appointments which seem worthy of a brief description. The rooms occupied for this purpose include about one-fourth of the available space of the second floor in the new building of the school at the corner of Boylston and Exeter Streets in Boston. The disposition of these rooms is shown in the accompanying plans (figs. 1 and 2). The large lecture-room, it will be seen, has also an ante-room leading to the chemical laboratories, which occupy the remainder of the floor, the lectures of both departments being given in this room. It may be mentioned here that the stories of the building are in general quite high, permitting the frequent use of mezzanines with great economy of space.

In the lecture-room itself the table is the most interesting feature. When ready for use, it is merely a plain black walnut table, with a thick top about 5 metres long, 90 centimetres wide, and 86 centimetres above the floor. On this are water and gas cocks (*W*, *G*), and a waste-pipe (*WP*), to which the overflow from any apparatus may be conducted. This pipe runs into a small open sink lying below that portion of the table, and having also its own water-supply. Near the middle of the table are the binding-posts of a pair of electric wires (*E*) coming from the general laboratory, and close to these is the air-pipe (*A*) from the respiration apparatus, to be presently described. The course of the wires and pipe beneath the floor is shown by a dotted line in the plan. At the same end of the table is a movable cover over a large pneumatic trough. Here, as elsewhere on the table, the water-supply is from a tank at the top of the building, so that the pressure is constant. As the pipes are independent, the necessary conditions of the water-supply for hydraulic experiments are satisfied. The middle half of the table presents more novel features. It is movable, running on wheels, and exists in duplicate, each of the two departments using the lecture-room being thus provided for. This section can be run off into the laboratory, and there loaded with any apparatus or material required for the lecture. It is thus possible to

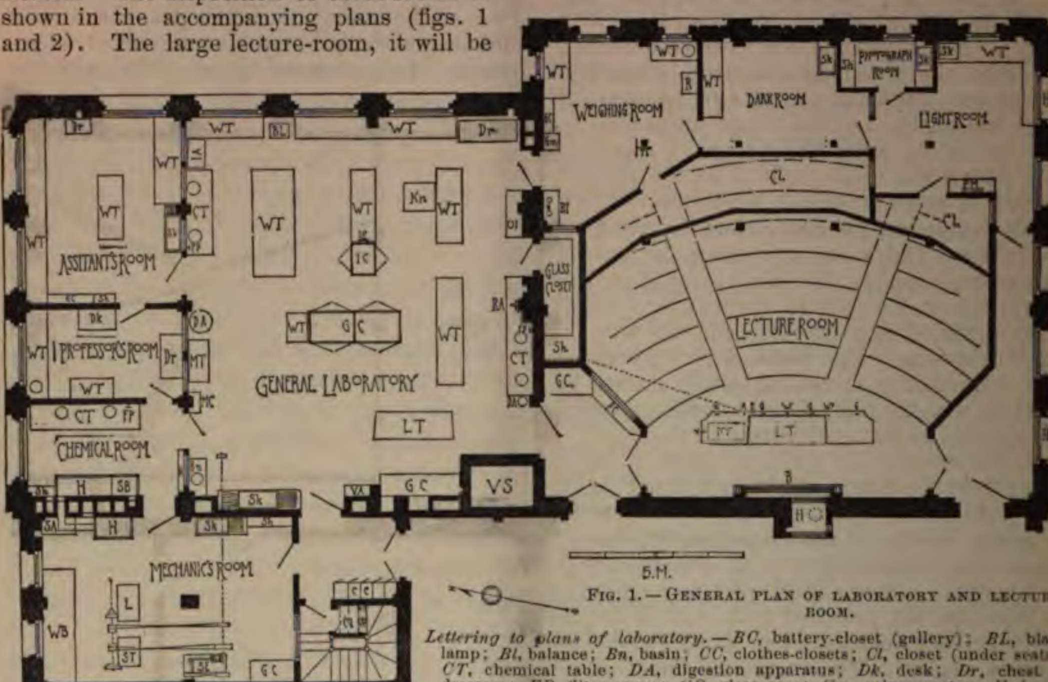


FIG. 1.—GENERAL PLAN OF LABORATORY AND LECTURE-ROOM.

Lettering to plans of laboratory.—*BC*, battery-closet (gallery); *BL*, blast-lamp; *Bl*, balance; *Bn*, basin; *CC*, clothes-closets; *Cl*, closet (under seats); *CT*, chemical table; *DA*, digestion apparatus; *Dk*, desk; *Dr*, chest of drawers; *FP*, filter-pump; *GC*, glass case; *Gm*, galvanometer; *H*, hood; *HS*, heliostat shelf; *IA*, injection apparatus; *IC*, interrupter case; *Kn*, kymographion; *L*, lathe; *LT*, lecture-table; *MC*, meat-cutter; *MT*, mercury-table; *OI*, operating instruments; *PC*, portfolio-case; *PM*, pendulum myograph; *R*, refrigerator; *RA*, respiration apparatus; *SA*, soldering apparatus; *SB*, steam-bath; *SE*, steam-engine; *Sh*, shelves; *Sk*, sink; *SP*, seconds pendulum; *ST*, saw-table; *Tl*, telescope; *VA*, varnishing apparatus; *VS*, ventilating shaft; *WB*, work-bench; *WT*, working-table. *Lecture-room.*—*A*, air-blast; *B*, blackboards; *E*, electricity; *G*, gas; *PT*, pneumatic trough; *W*, water; *WP*, waste-pipe.

prepare a difficult experiment much more readily and completely, or to leave complicated apparatus set up for some length of time. The section has also a set of drawers containing such operating instruments, glassware, towels, etc., as are constantly required in the demonstrations, a shelf below carrying sand-baths, lamps, and the like. In the plan the movable table (*LT*) stands in the laboratory, as when waiting for its lecture-load. Behind the table in the lecture-room are three sliding blackboards (*B*), 280 centimetres long and 120 centimetres wide, which run up and down in front of a small hood (*H*), communicating also with the adjoining chemical laboratory. In this way unpleasant smells or noxious gases are easily avoided; and apparatus may be set up while the lecture is going on. Along the upper edge of each blackboard is a small brass rod, which has been found convenient for suspending diagrams and tables. Below are cupboards for further lecture-supplies, four electric bells being placed at the side to summon various persons whose help may be required during the lecture. The seats slope upward with a gradually increasing pitch (in accordance with the rule of construction given by Lachez), so that each person in the audience has an equally good opportunity of seeing over the heads of those in front of him.[1] Above the seats is a broad platform or gallery leading to the entrances for students, and corresponding to the mezzanine of the floor. At the back of this gallery the windows are provided with shelves for such microscopical demonstrations as the lectures require. The room is lighted almost entirely from windows in the eastern and southern gallery; but, as the lectures for which the room was planned are usually delivered in the morning, no difficulty has arisen. A large chandelier has been found sufficient for the later hours of the winter afternoons and in the evening. A beam of light may be brought into the lecture-room by placing a heliostat on the shelf (*HS*) of the proper window in the southern wall of the building, and this ray can also be carried into the laboratory. At present no arrangements have been made to darken the lecture-room for lantern demonstrations; but this can be easily done, should it become desirable.

A small ante-room at the side opens both into the main hall and the general laboratory. The latter is a large room (10.8 by 9.6 metres) and of the full height (6.25 metres) of the story. Light is furnished by three large windows in the eastern wall, and by the five windows of the gallery at the northern end (see fig. 2). As the partition-wall which shuts off the small rooms is partly of glass, the light-supply is ample. A general view of this room and of the gallery, taken from a point near the door of the weighing-room, is given in fig. 3. The arrangement of the working-tables (*WT*) is evident from the plan. Those along the walls are firmly fixed in position, as is also the middle table adjoining the interrupter-case (*IC*): the other working-tables can be moved as required. Two chemical tables (*CT*), with the

FIG. 2. — HALF STORY.

necessary shelves and chemicals, bowls, and filter-pumps, furnish places for from six to eight students in the practical courses or for special work. The working-tables adjoining the kymographion (*Kn*) and interrupter-case (*IC*) can be extended to the long table below the windows by a board, which is hooked into position as needed. In this way it is possible for two persons to operate in the most favorable light and position. The cases holding the operating instruments (*OI*) will be seen to be very conveniently placed against the wall near the operating-table: at the side are shelves containing the ether, morphia, curare, etc., likely to be required.

The ventilation of this room, like that of the

[1] See Czermak: Ueber das physiologische privat-laboratorium an der Universität Leipzig. 1873.

building in general, is provided for by large shafts in the wall, which, however, for the sake of simplicity, are not fully indicated in the plan. There are similar shafts for warming the rooms with heated air. There are also numerous steam-radiators for the coldest weather. Besides the waste-pipes belonging to the sinks and bowls, shown in the plan, there are many extra waste-pipes with stop-cocks, to which, by means of hose, water may be carried off from any apparatus which can possibly be set up in any of the rooms. The sink in the north-western corner of the laboratory and the adjacent basin (*Bn*) have both hot and cold water. With one exception, the water-supply comes directly from the ordinary city pipes. The exception is the chemical table against the southern wall, which has an independent supply from the tank already mentioned, and therefore useful for hydraulic experiments.

To avoid any misapprehension, a word as to the purpose of this laboratory may not be out of place here. It is intended to serve primarily as a laboratory of research, and secondarily as an adjunct to the lectures on physiology in the preparation of suitable apparatus and experiments. Courses in 'practical physiology' are also given in the laboratory to the class in sections of a convenient size, but no instruction in 'biology' is contemplated. All histological work proper is carried on in a special department in another part of the building. It seems desirable to mention these things more particularly, lest any one should miss those features which are prominent in some American laboratories of recent date.

FIG. 3.—INTERIOR OF GENERAL LABORATORY.

The centre of the room is occupied by a large double case (*GC*), with glass doors on both sides, intended to hold such pieces of apparatus as are used in laboratory-work. Another glass case at the side of the room to the west serves the same purpose, while that in the little ante-room contains such special apparatus and preparations as are used regularly

in the lectures. Alongside the latter is a portfolio case (*PC*) for the diagrams and drawings required in the same courses. Near the large case in the laboratory is the structure familiarly known as the 'tower,' but called the interrupter-case (*IC*) in the plan, which has been found to be a great convenience. A view of the upper portion of the tower is given in fig. 4, the lower part being merely a large closet for wire and other supplies. Its purpose is to hold various pieces of apparatus for interrupting or regulating the galvanic current. As a rule, all the batteries made use of in the laboratory are set up as required in the battery-closet in the gallery, and connected with wires running to the tower, whence the current is conducted to the apparatus, or to wires running into the rooms where electricity may be needed, as well as to the lecture-table. The general relation of the wires to the battery-room and the tower is shown in the plan of the gallery (fig. 2). A special line of very large copper wires is also shown, which goes directly, without a break, to the remoter work-rooms. This line has been found necessary for the battery required to work a large Ruhmkorff coil at that distance. The present system of wires has been planned chiefly to meet the demands of ordinary work, but is capable of such extension as may be required. Outside the tower hangs the seconds pendulum (*SP*), which is heavy enough to swing for about half an hour. It can be put in any circuit, and thus give very exact time or regular interruption in any room of the department. In the tower itself the only pieces of apparatus considered permanencies are those seen in fig. 4, — a clock and a new interrupter, recently imported from Leipzig. The latter rather complicated instrument seen on the left of the figure has valuable features; the platinum contacts being under alcohol or petroleum, and so arranged that either the closing or opening induced current may be short-circuited. The rapidity of the shocks can be considerably varied within the limits of thirty in one second, and one in thirty seconds. This apparatus was constructed by Baltzar. In principle it is the same as that described by Bohr, in his article, "Ueber den einfluss der tetanisirenden irritamente auf form und grösse der tetanus curve" (*Arch. anat. u. physiol., physiol. abth.*, 1882, p. 233). Many changes have, however, been made in the details before the present form was arrived at. In this a metallic cylinder turned by clock-work carries two sets of pegs (like the pins in a musical box), which strike against levers, and thus break contacts in the trough below. The pins of each series are so set that the contact is broken in one lever a little sooner than in the other, and consequently is still broken in the latter when the former closes. In this way a simple change of the wires from the induction apparatus permits the short-circuiting of the opening or the closing induction shock at pleasure. By an ingenious arrangement a cog-wheel can be shifted so as to give the cylinder a very slow or a rapid motion, as desired: the series of pegs thus do double work, and permit the great range of interruptions already mentioned.

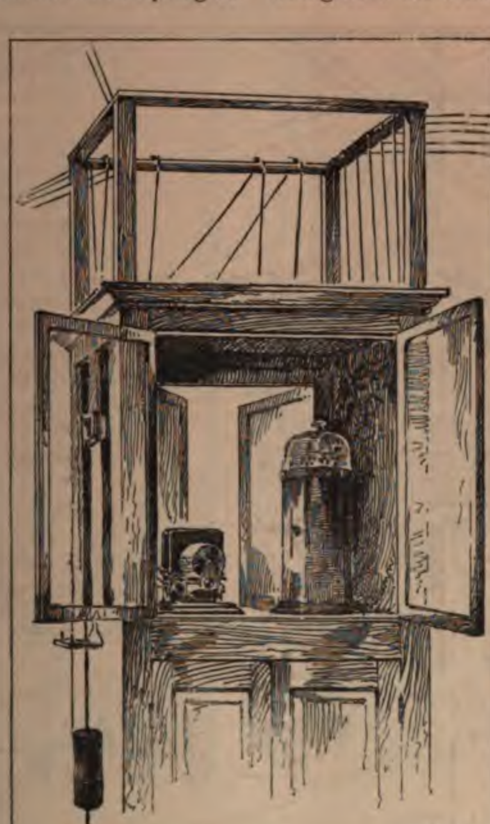


FIG. 4. — INTERRUPTER-CASE.

The clock, seen on the right of the figure, has a revolving pendulum, and a set of toothed wheels, which interrupt the electric current at intervals of one, two, three, four, five, ten, fifteen, twenty, thirty, or sixty seconds. The duration of the interruptions may be any thing less than four seconds. By using a relay these may be changed into closures of corresponding length and interval. This clock was con-

structed by Zachariae of Leipzig, and has been described by Dr. Bowditch in his communication, "Ueber die eigenthümlichkeiten der reizbarkeit, welche die muskelfasern des herzens zeigen" (*Ber. sächs. gesellsch. wiss. Leipzig*, xxiii. 1871, 658).

Besides the more ordinary forms of interrupter in common use, the laboratory possesses several home-made ones, which have proved useful, and are set up in the interrupter-case as required. One is merely a simplified Bernstein's acoustic interrupter, in which a steel bar of variable length (determined by a sliding clamp) is kept swinging by a temporary magnet above, while a platinum point makes and breaks in a cup of mercury below. Another very simple and inexpensive form, which is easily made, and probably admits of more general application, consists of a steel rod swinging on a knife-edge at one end, while the other is attached to a long spiral spring fixed above. The swing is determined by the tension of the spring, and the position of variable weights on the bar. This arrangement has proved useful for slow interruptions, one to three in a second, the apparatus before mentioned permitting four to ninety in the second.

Against the wall, above the end of the chemical table on the southern side of the room, is the respiration apparatus (*RA*), whose construction is made clearer by the adjoining sketch (fig. 5). It is merely a water-bellows of the ordinary form, receiving its water-supply by the upper pipe at the right, from the constant-pressure tank at the top of the building. The water enters the upper cylinder (*J*), and passes down through the pipes marked *K*, into the air-chamber in the basement two stories below, the compressed air coming up to the laboratory by the pipe *L*. If the water enter the bellows by the lower stop-cock (*C*), a steady blast of air is obtained, which may work a blast-lamp at *P*, or, by a proper closing of the stop-cocks, be carried to the glass-blowing table (*BL*), 10.5 metres away; a gas-pipe (*N*) being laid for this purpose along the wall, and under the edge of the long working-table. By a different closure of the stop-cocks, the air-stream is directed to the lecture-room through the pipe *M*, reaching the table at *A*. Rubber hose attached to a stop-cock below the long wall-table permits the use of the same blast of air on any of the other working-tables of the room. If the upper stop-cock (*B*) be opened, and the lower one (*C*) be closed, the water passes through a small motor (*A*) before entering the bellows; thus doing double work, first in falling from the tank to the motor, and then in falling further to the basement. The motor gives motion to the cone below, and a small stop-cock in the axis at *D* regularly breaks the otherwise constant stream of air, which, opening the stop-cock *H*, and closing that at *G*, permits free passage to this portion of the apparatus. A slotted cap (*I*) regulates the amount of air delivered, while the rapidity of the interruptions can be nicely adjusted by the amount of water flowing through the motor, and by the size of the wheel used on the cone. Another combination of high pressure and slow movement can be obtained by so adjusting the stop-cocks *B* and *C* that more or less water enters the bellows without passing through the motor. The large wheel and the cone are on sliding boards, so that

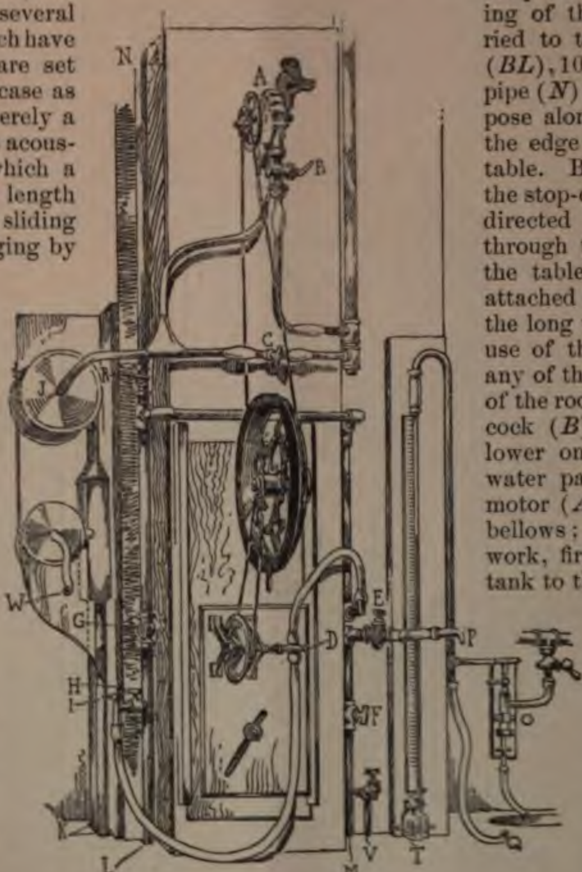
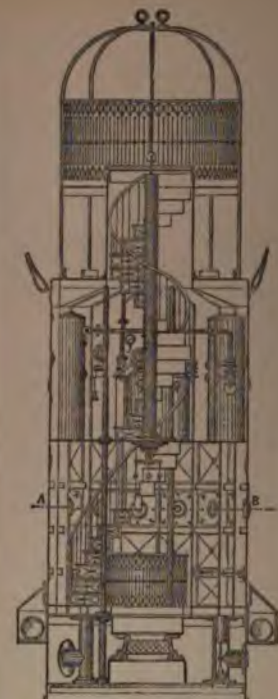


FIG. 5.—RESPIRATION APPARATUS.

Lettering to respiration apparatus.—*A*, water-motor; *BC*, stop-cocks for water-supply; *D*, revolving stop-cock; *EFGHR*, stop-cocks directing stream of air; *I*, regulating-cap; *JKW*, water-bellows; *L*, air-supply from bellows; *M*, pipe to lecture-room; *N*, pipe to working-tables; *O*, filter-pump; *P*, air-pipe for blast-lamp; *Q*, rubber pipe of filter-pump; *T*, mercury-gauge; *V*, gas for blast-lamp; *W*, air-inlet to bellows.



Section through A B.

A piece of a

A proposed diving-chamber supplied with compressed air to be used in submarine explorations. — *La Nature.*

The leaf-butterfly, flying and alighted. — *Science monthly.*

Meteorological and chemical laboratory on P
atmospheric phenomena. — *Scie*

SELECTED ILLUSTRATIONS

...OLOGICAL AND CHEMICAL LABORATORY ON PIC DU ... FOR THE STUDY OF ATMOSPHERIC PHENOMENA. THE ...L LABORATORY OF MÜNTZ AND AUBIN FOR THE IN-...ATION OF THE CHEMISTRY OF THE AIR.—*Science et* ...

VERTICAL RAY SEEN FROM PARIS, MARCH 20, JUST AFTER SUNSET.—*L'Illustration.*

HALO SEEN FROM THE OBSERVATORY OF THE PARC DE SAINT-MARC, MARCH 25, AT 11 A.M.—L'Illustration.

the tension of the belts may be readily regulated. This form of stop-cock was arranged some years ago by Dr. Bowditch, to be run by the clock-work of the kymographion, and has been described by him in the *Journal of physiology* (ii. 3, p. 202). This interrupted blast of air is carried by the pipes already mentioned to any table where it is required. The system was planned for the present needs of laboratory-work, but could be readily extended even to other work-rooms. It has thus far proved quite satisfactory, and readily adaptable to the artificial respiration of dogs, cats, or rabbits.

Adjoining the respiration apparatus, the sketch shows a filter-pump (O) and its simple mercury-gauge (T), which can be attached to the same system of piping, and used at a distance. This is done by connecting the rubber tube Q with the pipe P. Although the system was not originally planned for use with negative air-pressures (the revolving stop-cock not being quite tight enough for such a purpose), it is very easy to produce a negative pressure of two hundred and forty millimetres (mercury) on the table in the lecture-room, or on the more remote working-tables of the general laboratory.

At the other end of the room is a small mercury-table (MT). This is merely an ordinary table, with a raised edge, made tight and thoroughly varnished. A little shelf at one corner holds a bottle to catch the refuse mercury directed to a hole in this corner by a suitable shortening of the legs. A firm shelf on the pilaster near by holds a small meat-cutter (MC), and a press for extracting meat-juice and the like. At the other side of the mercury-table stands the large digestion apparatus (DA), or constant temperature box. This consists of two cylindrical boxes of sheet-copper of different sizes, joined by a rim at the top, and resting on legs made of iron rods. The inner box has a diameter of forty centimetres and a depth of twenty-nine centimetres, the corresponding dimensions of the outer casing being fifty-eight and thirty-eight centimetres respectively. The rim has two holes for corks carrying a thermometer and a glass tube of the regulator. At the side is a stop-cock for removing the water which fills the space between the two shells. The inner box is the air-chamber, and has a double-walled cover packed with charcoal. An extra cover has also been made, a thick wooden rim carrying two plates of glass, with an air-space between, so that any changes going on in the chamber kept at a constant temperature may be followed without removing the cover. The apparatus stands thirty centimetres above the floor, and, being covered with a layer of asbestos packing two centimetres thick, it parts with its heat so slowly that a single Bunsen burner suffices to keep it at a temperature of 60° C. The size of flame is determined by a glycerine regulator. A large glass tube suspended in the water contains the glycerine, which also fills a rubber tube communicating on a shelf above with the regulator, and ending in a small funnel. The glycerine, as the water warms, expands, and rises into the funnel, until, at the desired temperature, a stop-cock is closed. After this any further expansion forces a rubber membrane against the end of the gas-pipe above, and shuts off the main gas-supply to the flame, leaving only a small amount regulated by another stop-cock, the 'pin-hole' of the ordinary mercury regulators. The contraction of the glycerine, on cooling, draws the membrane down again, and thus increases the gas-supply. This regulator has been found very trustworthy; and the temperature of the air-chamber has remained quite constant for weeks at a time, with only a very small flame. Only temperatures from 38° to 60° C. have been tested, but for these the variation has not exceeded half a degree C. As the volume of water to be heated is large, about sixty-four litres, considerable time is required to raise the temperature sufficiently; and this is the only practical objection to the apparatus. This is, of course, compensated for by the size of the air-chamber, rather over thirty-six litres. For experiments calling for speed, there is a small digestion apparatus at the table near the lecture-room. This is merely a water-bath, with an ordinary mercury regulator, and a water-supply from a Mariotte's flask on the shelf at the back. For lecture demonstrations of artificial digestion, the laboratory has another piece of movable apparatus of convenient size and some elegance.

Adjoining the glass case on the western wall is the varnishing apparatus (VA). This is a simple tin trough, slightly tipped at one end, where a rubber pipe runs to a supply-bottle, whose position on the shelves at the side determines the filling or emptying of the trough. The smoked papers are run through the varnish, and then suspended from rods, to drip into the trough, and thus into the bottle. This form of apparatus was originally devised by Professor Kronecker of Berlin.

In the north-eastern corner of the laboratory, adjoining the chemical table, stands a large and convenient injection apparatus (IA) for the

preparation of animals or organs for microscopic work. It is merely a copper box, used as a water-bath, big enough to hold a large cat and several bottles of injection-material. Pressure is obtained by letting water from the tap run into a large bottle below the table. The compressed air then forces the injection-mass into the body, every thing being kept at a suitable temperature by a lamp below. By using T-tubes several vessels may be injected with different substances at the same time. On a small table by itself, but at the side of one of the working-tables, is the kymographion (Kn). This is of the Ludwig pattern, with a long roll of paper. It has special wires from the tower and from the pendulum. Over the kymographion is a large cover of painted cloth, stretched on a light wooden frame. By aid of a pulley in the ceiling, this cover is raised or lowered as required. A similar cover hangs above the table adjoining the pendulum, and an extra one is on hand to be placed where needed. The use of these dust-proof protectors makes it possible to keep complicated or delicate apparatus together for an experiment of indefinite duration, and safe from all ordinary disturbance when work is not going on.

To the north the main laboratory opens directly into two small rooms of less height, half-stories in fact, — the chemical room and that of the assistant. Between the two is the small private room of the professor. This contains working-tables, with water and gas, and can be conveniently used for private work. The assistant's room has also a long work-table especially arranged, as regards light and height, for microscopical work; and the room is, in fact, partly occupied at present for the preparation of material for histological demonstrations. This arrangement was made for the economical use of the animal supplies of the department. Another large table is intended for the examination of curves and records. There are also all the conveniences in the way of gas, water, waste-pipes, and electrical wires, needed to make the room convenient for private work. The chemical room has a large work-table, with numerous drawers to hold the more delicate glass apparatus. There are also the necessary shelves for chemicals and reagents. At the side of the commodious hood is a steam-bath, which has proved a great convenience. The fittings of the room, and the apparatus, are merely such as are required for ordinary physiological work, the nearness of the chemical laboratory on the same floor making a larger room for this purpose unnecessary.

The chemical room opens directly into the workshop of the laboratory, where the instruments are cared for and repaired, and where not a little even of the more delicate apparatus can be made. This room has its own sink and hood for such work as may be unpleasant to the nose, or otherwise irritating. A large and convenient work-bench occupies nearly all the northern end of the room. More in the centre of the room are the lathe (L) and saw-table (ST), each capable of receiving motion from the little steam-engine (SE), of about two and a half horse-power. This receives steam from the same pipes which come to the steam-bath already mentioned. The shafting at present runs only a few feet into the main laboratory, but can be readily extended as occasion shall require.

At the chief entrance of the main laboratory and the mechanic's room is a small ante-room with clothes-closets (CC) for those regularly working in the department. This room also opens upon the staircase leading to the room above, and to the 'gallery' of the general laboratory, these forming the mezzanine of this portion of the floor. Their arrangement is seen in the second plan (fig. 2). This space has been left more or less open with a view to its future adaptation to such needs as shall arise. A portion of that over the mechanic's room will probably soon be shut off by a glass partition, to make a quiet reading-room which will hold the working-library of the department. The larger space over the small rooms has its own hood and a water-supply, and is well provided with gas. During the past year, extended experiments in bacilliculture have been carried on here. A part is soon to be fitted up with large plain tables for the courses in practical physiology, which are given for the students of the first year in as large sections as can be conveniently managed. It would be easy at any time to make this space into several separate rooms, should they be required.

At the end of the gallery proper, along the wall to the west, is the battery-closet (BC). This opens into its own ventilating-shaft, and has two large soapstone sinks, in one of which the battery plates and cups are washed, the other serving to hold the porous cups kept constantly under water. On shelves at the side are large bottles with glass stop-cocks to hold the acids and other solutions. A glass case near by contains such battery-material as is not in frequent use, or fails to find room in the large storage-drawers below the closet. Should such a necessity arise, a broad gallery could also be built along the southern wall of the large room.

The door in the middle of this southern wall on the main floor opens into a large closet, a store-room for glassware. The remaining door leads to a set of smaller rooms under the gallery of the lecture-room, intended for special work, and to be more fully fitted up at some future time, or as the needs of investigation shall make desirable.

Under the seats and openings into two of these small rooms are closets, dotted in the plan, which are convenient places for storage. The first of these rooms is known as the 'weighing-room.' It contains a delicate balance (*Bl*) on a firm shelf, and a Wiedemann's galvanometer (*Gm*) fixed on a pier near the door. The telescope (*Tl*) of the latter is attached to a column in the centre of the room. In the corner is a small refrigerator (*R*) with a waste-pipe. This room, as well as its neighbors, has water, gas, and wires from the tower. The next, or 'dark room,' has no windows, and is intended for optical experiments, or for any work requiring the exclusion or perfect control of daylight. A shutter near the door to the south permits any arrangement of diaphragms and lenses which can possibly be called for. At some future time a Thomson galvanometer will be set up in this room.

The corner room, known as the 'light-room,' has no special purpose, but is to be used for such work as may require a very good light and perfect quiet. The position of this room, in the corner of the building farthest removed from the streets, is very favorable for uninterrupted, quiet investigation. In one corner is the 'photograph-room' for the preparation and development of the plates. Against the wall, in the opposite corner, a pendulum myograph (*PM*) is fastened permanently in position, and covered by a dust-proof case. This is the instrument made by Dr. J. J. Putnam, and described by him in the *Journal of physiology* (ii. p. 206). Wires run from this apparatus to the adjoining closet,—an arrangement that is found convenient for experiments with reaction time. One of the southern windows of the light-room has also a broad heliostat shelf (*HS*) outside, so that a beam of light may be sent even into the assistant's room, or, by a suitable disposition of mirrors, into any part of any other room. The remaining door of the light-room opens upon a passage-way which leads to the chemical laboratories, and makes the departments independent of the main hall or the lecture-room for communication.

KRAKATOA.

THE more the information accumulates with regard to the eruption of Krakatoa on Aug. 27, 1883, the more this phenomenon proves to have been remarkable and unique as a series of violent explosions.

From *Nature* of July 17 we learn, that, at the meeting of the Meteorological society of Mauritius on May 22, several interesting communications were made with regard to this eruption; among others, a letter from a M. Lecomte, dated at Diego Garcia (latitude 7° 20′ south, longitude 72° 35′ east of Greenwich) on April 24, describing how at breakfast, on the morning of Aug. 27, they had heard detonations, low but violent, and, attributing them to a vessel in distress, had run, and had sent men, to different points of the shore of the island, who were unable to see any thing to cause such sounds; also how the captain and mate of the Eva Joshua, just leaving Pointe de l'Est to anchor at Pointe Marianne (these places I cannot find, but suppose, from the account, that they are near Diego Garcia), had heard the same detonations, and sent men to the mast-heads, without seeing any thing. These, with the previous reports from Rodriguez, showed that in three distinct cases the sounds of the Krakatoa explosions were plainly heard at distances of at least twenty-two hundred miles, and, in the case of Rodriguez, of nearly three thousand.

It will be remembered, that in *Nature*, May 1, it was stated by Herr R. D. M. Verbeek that these sounds were heard in Ceylon, Burmah, Manila, New Guinea, and at Perth on the west coast of Australia, and, in fact, at all places within a radius of about 30°, or two thousand miles. But these later reports from Rodriguez and Diego Garcia show, that across the waters of the Indian Ocean, with no land intervening, they were carried distinctly to much greater distances.

The still more remarkable atmospheric gravity-waves which travelled round and round the globe in all directions from the Straits of Sunda, and which were fortunately registered on the self-recording pressure-guage of the large gasometer at Batavia, close by Krakatoa, were also registered on the barograms at Mauritius; and here there were distinctly recorded four successive transits of the waves from east to west, and three from west to east, the same as shown by Gen. Strachey to have occurred at some of the European stations. But, what is still more remarkable, there is a faint trace of a *fifth* transit of the waves from east to west on the morning of Sept. 2; i.e., *more than six days after the explosions*, and when the waves had travelled *more than four times round the earth*, or about a hundred and two thousand miles. The most sensitive barograph at the signal-office in Washington also shows small waves, which are probably the record, also, of this fifth transit (and barely possibly of the succeeding *sixth* transit of the same): but the phenomena at Washington are complicated by the fact that it is within about 33° of the antipodes of Krakatoa, and that the waves have different velocities east and west,

and also that the great circle through Krakatoa and Washington passes nearly over the poles, and in this direction the velocity seems to be still smaller; so that the phenomena for this region become more and more complicated for each succeeding transit, and, after the first two or three in each direction, rather difficult to unravel. Unfortunately, the other few barographs in use on this side the Atlantic — to all of which the great circles from Krakatoa take an entirely different direction from that to all the eastern stations — are not so sensitive as the best Washington barograph, and do not help much beyond the first two transits of the waves in each direction.

It is noteworthy that these barometric disturbances were first noticed at Mauritius early in September, soon after their occurrence, and were at once independently attributed to the Krakatoa eruption, but were supposed to be due to successive series of explosions day after day, until the publication long after, in *Nature*, Dec. 20, of the discovery of Mr. Scott and Gen. Strachey, showed them to be due to a single series of waves, travelling round and round the globe, from the explosions of Aug. 27.

Perhaps the most interesting and important fact appearing from these Mauritius records, in connection with these waves, is the difference in time of transit round the earth, as compared with that deduced from the European stations by Gen. Strachey. The paths of the waves from Krakatoa to the latter stations are, on the average, something like 40° north of west (from Krakatoa), and, to Mauritius, about 20° south of west; so that the great circles make an angle of about 60°. The difference in time of transit on these circles, and in the two directions on each, are best shown in the table below, where, following Gen. Strachey's nomenclature, the successive waves are numbered from i. to vii., and the odd numbers denote the transits from east to west, and the even those from west to east.

	i. to iii.	iii. to v.	v. to vii.	Mean.	ii. to iv.	iv. to vi.	Mean.
	S. E. to N. W.				N. W. to S. E.		
	h. m.	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*
European . . .	37 4	36 54	36 48	36 57	35 24	35 9	35 17
	N. E. to S. W.				S. W. to N. E.		
	h. m.	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*	*h. m.*
Mauritius . . .	34 34	34 37	34 43	34 38	35 15	36 13	35 44

Of course, all the above numbers are liable to an uncertainty of several minutes; but, even when this is considered, the differences are quite marked. While the average time of transit *viâ* Europe is 1 h. 40 m. *greater* going west than going east, *viâ* Mauritius it is 1 h. 6 m. *less;* indicating, as far as atmospheric currents are concerned, an opposite effect on these two great circles, which make, roughly, an angle of 60° with each other. The peculiar progression in the individual periods for successive transits can hardly be wholly accidental, and is in opposite directions; the waves *viâ* Europe going (in each direction) faster and faster, and *viâ* Mauritius being retarded. Perhaps the most striking difference is, that the mean period, regardless of direction, is nearly 1 h. less *viâ* Mauritius than *viâ* Europe, — a fact most strikingly shown by taking the whole interval vii.–i., which, for the five European stations where vii. was traced, gives 110 h. 50 m., and, for Mauritius, 103 h. 54 m.; showing the wave to have gone three times round the earth *seven hours quicker viâ* the more equatorial route, which is probably partly due to the higher temperature of the atmosphere along this path, and also, perhaps, to the fact that this great circle passes over about as little land as any that can be drawn through Krakatoa.

These facts show more forcibly how complicated the phenomena must have been near the antipodes of Krakatoa, and also at the latter place, upon the returns of the waves there. It is evident, that, when the Krakatoa committee of the Royal society shall have collected all the data, many interesting problems will arise in connection with these atmospheric waves; and, in connection with the distribution of Krakatoa dust by the upper currents (which, it may now be regarded as pretty well settled, was the cause of the wide-spread red-sunset phenomena), the explosive eruption of Krakatoa promises, if thoroughly investigated, to teach us more about the circulation of our atmosphere than years of ordinary meteorological study could have done. H. M. PAUL.

Washington, July 29.

OVERWORK IN GERMAN SCHOOLS.

AFTER forty-two years' experience, it is now virtually conceded in Germany that physical exercise is not a sufficient antidote to brain-pressure, but that where the evil exists, the remedy must be sought in the removal of the cause.

Official action with reference to over-pressure has been taken in Prussia, Saxony, Würtemberg, Baden, Hesse, and Alsace Lorraine. In each instance it is based upon the report of a commission of inquiry, consisting of school directors, and members of school boards, as well as physicians.

The official action based upon the reports of the commissions is embodied in decrees dealing with the scope and method of teaching, the number and hours of study in school, and the amount of home-study.

The Hessian government issued decrees about home-study in 1877, and again in 1881. Complaints of overwork increasing, a commission was appointed to make further investigation, and report in full. Their recommendations were, in the main, embodied in the decrees of Feb. 23, 1883. By these decrees a maximum of home-study was fixed for each class, amounting for the lowest classes to an hour a day; the quantity of Latin and Greek required was diminished; and all tests of the student's progress that

necessitate much reviewing were forbidden. It was expressly ordered that the day and hour for test-exercises "shall not be announced to students more than twenty-four hours before they take place."

The Saxon decrees dated March 4 and 10, 1882, give particular directions as to the scope and methods of instruction, leaving the matter of study-hours untouched. They set forth that instruction in the classical languages is carried to excess in the gymnasia, being in many cases turned into teaching philology as a profession instead of being conducted as a means of general intellectual training. With reference to the '*extemporalia*' that form a prominent exercise in many of the Saxon gymnasia, the decrees are very pronounced. These essays which the students are required to translate and write down in a foreign language from dictation, are often, it is asserted, mere collections of questions in syntax, calculated to produce in the student "a feeling of anxiety and vexation instead of an agreeable consciousness of knowledge." The result in the student is nervous excitement and subsequent intellectual torpor,— conditions from which the young should be carefully guarded.

The Baden ministry published an outline of a decree, March 18, 1883, that had been prepared by the board of health, in conference with a number of teachers. Previous to this time, the different classes of the gymnasia had thirty, thirty-one, thirty-two, and thirty-four hours of study a week, without counting elective studies and gymnastics. These are now reduced to twenty-eight and thirty-two hours for the two groups of classes below and above the secunda. Before 1869 the total number of hours of study for a Baden gymnasium of nine classes was 269 a week, in 1869 it was raised to 286, and it is now 268. Each study-hour is limited to fifty minutes. The amount of home-study is also definitely fixed, and the course of instruction modified somewhat. As an evidence of the necessity of these changes, Professor Baumeister points out that in the lowest class of a gymnasium 1,300 Latin words have to be learned the first quarter of the year, and nearly as many the second, making a daily average of about twenty words. These words, he observes, are not met with in any authors read by the boys till they reach the upper classes, and are generally expressions of ancient life, of which a nine-year old boy knows nothing. The intellectual effort required to memorize these words, leads, he holds, to injurious and lasting effects.

The commission appointed by the stadtholder of Alsace Lorraine recommended that the number of study-hours should be restricted to twenty-six a week for the lowest classes of the gymnasia, and to twenty-eight and thirty-two for the higher; that the hours of home-study should be eight, twelve, and eighteen a week, progressing from the lowest class to the highest; and that six hours a week should be devoted to general physical exercise, including swimming, open-air sports, skating, and excursions. While the existing conditions will be somewhat ameliorated by these decrees, they do not seem to have brought about a final solution of the difficulty. Last year a petition upon the subject, signed by eminent teachers, physicians, and other citizens, was addressed to the Prussian chamber of deputies. After setting forth the deplorable effects of the excessive strain upon the nervous system of scholars, it appealed to the patriotism of the deputies to put an end to the abuse which, the petition asserts, "threatens little by little to reduce the cultivated classes of society to a state of moral weakness that shall render them incapable of great and manly resolution."

A PROPOSED NEW DEPARTURE IN HYGROMETRY.

IN the *Comptes rendus* for June 30, Mr. Jamin, the newly elected perpetual secretary of the French Académie des sciences, proposes a new departure in hygrometry.

The present system of expressing the amount of vapor of water in the atmosphere is to give the ratio $\frac{f}{F}$, of the observed elastic force f, to the maximum F, which the vapor would have at the same temperature if the atmosphere were saturated with it, i.e., were at the dew-point; and this is called the 'relative humidity.' Now, as this maximum F for the point of saturation does not by any means correspond to a constant ratio between the mass of the vapor of water in the air and the mass of its other constituents, but varies largely with the temperature, so that cold air will not hold nearly so much vapor of water as warm air, this system of expressing the amount of this vapor as a percentage of another percentage which is itself very variable, is, in the opinion of Mr. Jamin, a vicious one, at least for many purposes of meteorology.

In its stead he proposes to substitute just what a chemical analysis of the air in question would give; viz., its 'hygrometric richness' as given by the ratio of the amount of vapor of water to that of the other constituents, and as expressed in *volume* by the fraction $\frac{f}{H-f}$, or in *mass* by $0.622\,\frac{f}{H-f}$, in which H is the total pressure of the atmosphere, and the denominator consequently denotes that of dry air, or of all the other constituents but water-vapor.

Since observation does not give directly the relative humidity, but this is derived from an auxiliary table, Mr. Jamin shows that a table can be constructed which will just as readily give the hygrometric richness, for which he proposes to adopt the volume-measure $\frac{f}{H-f}$; and he states that such a table will hereafter be published in the *Annales du bureau central météorologique*.

While the present system has its advantages in showing approximately the nearness to the dew-point, and hence to cloud-formation and possible fall of rain or snow, yet it would seem, that for the wider study of total rainfall and evaporation, in fact of the general diurnal and annual circulation of water between

earth and sky, the proposed plan of Mr. Jamin is the only logical one; and it deserves, and, coming from such a source, will no doubt receive, the thorough consideration of meteorologists. H. M. PAUL.

Washington, July 22.

INDIAN LANGUAGES OF SOUTH AMERICA.

THE Indian languages of South America certainly deserve to be investigated as thoroughly as any other languages of the globe; but, unfortunately, there are only a few men who make of them an object of research. Abstracts of their grammatic elements have been published, from earlier sources chiefly, by Professor Friedr. Müller in his 'Grundzüge der sprachwissenschaft,' and by Lucien Adam in his 'Examen grammatical de seize langues Américaines' (Paris, 1882). The following treatises, published of late, have come to our notice, and have added considerably to our knowledge of these curious forms of human speech: 1°. Dr. Julius Platzmann's 'Glossar der feuerländischen sprache.' This is an attempt to present the Yahgan dialect of the Fuegian Islands in lexical form, and is chiefly based upon a Fuegian translation of the Gospel of St. Luke. It is preceded by four historical and topographical articles, composed by Dr. Karl Whistling, enlarging upon physical peculiarities of these islands. 2°. The first results of a scientific exploration of the Fuegian Islands by Bove, aided by the government of Italy, have been made public by Giacomo Bove, in his 'I Fuegini, secondo l'ultimo suo viaggio' (Parte prima, Genova, 1883). Extensive vocabularies of the language are published in this volume. 3°. A manuscript of 1818, by John Luccok, containing grammatical elements and a vocabulary of the Tupi language or lingoa geral of Brazil, was published at Rio de Janeiro by H. Laemmert & Co., 1882. Curiously enough, the titlepage contains the statement that the material is 'badly arranged.' 4°. Dr. Julius Platzmann's facsimile edition of Havestadt's book on Chilidúgu, which has been previously referred to in *Science*, iii. 550. 5°. A short ethnographic and linguistic article on the Indians of Antioquia and of the Cauca valley, Columbian Union, was published by R. B. White, F. G. S., in the *Journal of the anthropological institute of Great Britain and Ireland*, 1884. It contains vocabularies of the Noánama and Tadó dialects of the Chocó linguistic family. 6°. In the form of vocabularies of about two hundred terms each, seven Bolivian languages are given by Dr. Edwin R. Heath in the April number (1883) of the *Kansas city review*. These languages are the Canichána, Cayuába, Mobíma, Moseténa, Pacavára, Marópa, and Tacána. The author has given a graphic account of his travels through that deserted and malarial country in the *Transactions of the American geographical society of New York*, 1883. 7°. The foreign and Indian words introduced into the Portuguese of Brazil were collected by Braz da Costa Rabim in the *Rivista trimensal* of Rio Janeiro, vol. xlv., under the title 'Vocabulos indigenas e outros introduzidos no uzo vulgar.' 8°. An array of notices of former travellers upon the Aimorés has been gathered by A. H. Keane, professor at the London university, partly anthropological, partly ethnographical, with a short linguistic appendix, and published with his own remarks in the *Journal of the anthropological institute*, November, 1883 (15 pages, 8°), under the superscription 'On the Botocudos.' The tribal name, Aimorés ('vagrant enemies'), is preferable to and much older than Botocudos ('the ones wearing the lip-ornament'), which applies to many other South-American tribes just as well. Another name, the one by which they call themselves, is Nkrä'kmun (or 'men, people').

THE NEW BOGOSLOFF VOLCANO.

THE Grewingk or New Bogosloff volcano, described in *Science* (Jan. 25, 1884) from observations made last fall by Capts. Hague and Anderson, was visited by the revenue-cutter Thomas Corwin on the 20th of last May. Photographs and reports have been received at the treasury department which add considerably to our knowledge of its condition. It appears that the two peaks are united by a low dry spit, or bar, of sand and gravel which has doubtless been thrown up by the sea; and Ship Rock now rises from this bar nearly midway between the two peaks. Ship Rock, which is a nearly perpendicular pillar, seems, from the position of the barnacles on its base, to have been raised about twenty feet above its old level. The Bogosloff peak seems to have suffered by the commotion attending the eruption, as the Corwin party estimates its height to be about five hundred feet, while observations in 1873 by the U. S. coast survey gave it a height of over eight hundred feet, the upper third of which was composed of extremely acute, inaccessible pinnacles. As this determination was dependent upon a base-line measured by a patent log, which might have been put considerably in error by currents, too much dependence must not be placed on the discrepancy; nevertheless, as older observations all gave a greater height still, it is probable that a considerable change has taken place, if the Corwin's estimate be correct. The Grewingk cone was stated to be eight hundred or a thousand feet in height, and three-quarters of a mile in diameter, by Capt. Hague. It is now reported to be nearly the same height as the Bogosloff peak, or some four hundred and fifty feet in height and half a mile in diameter. Until the details of the survey are received, no exact figures can be given. A convenient landing-place is formed by the bight on either side of the sand-spit above mentioned, where the shore is also bold, there being three fathoms under the stern, with the boat's head on the beach. Farther off, the soundings are regular for a short distance, and then drop to a considerable depth; north from the Grewingk peak, however, no bottom could be found close in with ninety fathoms of line. The observations for position do not seem to have been very good, owing to cloudy weather, but showed a close correspondence with earlier determinations.

The summit of Grewingk was generally invisible from the clouds of steam which issued from many points of its surface, but no crater seems to exist. A sort of fissure existed in the south-west side, and two or three different pinnacles could be seen at the top when the wind drifted the steam away for a moment. Some of the jets of vapor were steady, others intermittent. No noise accompanied the ejection of steam. The cone is composed of very different materials, most of which seem to have been upheaved from the sea-bottom; such as large bowlders, blocks of sandstone, small pieces of shale, etc., all more or less covered with sand and fine pumice-ashes, into which one sank to the depth of a foot or more in attempting the ascent. No lava was seen, nor any cindery rock. The ascent was checked by the heat of the ashes, and the clouds of sulphurous steam, at a height of about two hundred feet. The stones about the jets exhibited incrustations of iron and sulphur; the latter forming large dendritic masses of a greenish color, which, at a little distance, looked like vegetation. The north-east slope of the cone was steeper than the south-western one, but more regular.

The Bogosloff peak was alive with sea-fowl and sea-lions, but was destitute of vegetation. It showed no signs of volcanic activity. The volcanic ash exactly resembled that which fell at Unalashka Oct. 20, 1883, and the latter doubtless came from Bogosloff Island. The island, in its new form, is about a mile and a quarter in length, and half a mile in extreme width, trending north-west and south-east by compass. The Corwin will visit it again on her return from the north in the autumn.

NOTES AND NEWS.

THE editor has received an acknowledgment from Dr. Anton Fritsch of the money forwarded to him, as already announced in *Science*, on behalf of American geologists toward a memorial tablet to Barrande. This tablet has been erected, at a cost of more than six hundred florins (of which 175.60 were sent from America), on a cliff at Kuchelbad, and is represented in the accompanying illustration from a photograph sent by him. Dr. Fritsch returns his best thanks to the American donors in the name of the natural-history section of the Prague museum, and says that the publication of this proof of sympathy has made a deep impression upon his countrymen. The list of American subscribers was printed in *Vesmír* for July 1. From the same paper we learn that the Barrande fund for researches in the Silurian formation of Bohemia has reached 4,200 florins.

— Among the names of our scientific friends in Great Britain who have been mentioned as intending to visit America for the meetings of the British and American associations, we find the following: Professor Adams, Mr. John Ball, Professor Robert Ball, Mr. C. S. Bate, Mr. R. M. Barrington, Prof. H. C. Bastian, Mr. A. W. Bennett, Mr. W. T. Blanford, Professor Bonney, Miss A. Buckland, Mr. W. L. Carpenter, Mr. W. Carruthers, Professor George Darwin, Mr. G. E. Dobson, Professor James Geikie, Mr. J. Glaisher, Professor Haddon, Mr. E. de Hamel, Dr. G. Harley, Professor Lawson, Sir John Lubbock, Professor MacKendrick, Professor MacNab, Professor Milnes Marshall, Professor Moseley, Lord Rayleigh, Sir E. Roscoe, Sir E. Ommanney, Mr. H. Saunders,

Mr. P. L. Sclater, Mr. A. Sedgwick, Mr. H. Seebohm, Mr. T. W. Sorby, Sir William Thomson, and Dr. E. S. Tylor.

— The National electrical commission met in Philadelphia on Aug. 7. It was decided that the conference to be conducted by the commission will be called for Monday, Sept. 8, to be then continued from day to day, as may be found necessary. The invitations to the conference will be confined to physicists of eminence, and to experts in the practical management of electrical appliances and apparatus. It is proposed to extend special invitations to prominent foreign visiting electricians. It was also decided to issue a circular inviting the conferees to submit papers to be read before the conference.

It is not definitely known what subjects will be discussed at the conference, but the following matters have been suggested: the sources of electrical energy; the theoretical conditions necessary to the most efficient construction of the dynamo-electric machine for the various purposes of practical work; the electrical transmission of energy; the systems of arc and incandescent lighting; the theory of the electric arc, storage batteries, electro-metallurgy; lighthouses for the coast; applications of electricity to military and mining engineering; lightning protection; induction in telephone lines, and the problem of long-distance telephoning; the question of underground wires; atmospheric electricity; earth-currents and terrestrial magnetism; photometry and standards for photometric measurements; the ratio of the electro-magnetic to the electro-static system of units, and the electro-magnetic theory of light; and finally, on account of the pressing necessity for accurate and uniform electrical measurements, it is probable that the question of establishing a National bureau of physical standards will receive proper attention.

— The circulars concerning the proposed international scientific congress, to which reference was made in No. 77, have been issued; and the names of the signers received up to Aug. 4 are: of the special committee on the part of the American association, T. Sterry Hunt, S. Newcomb; officers of the association, George F. Barker, F. W. Putnam, Edw. D. Cope, John W. Langley, William H. Holmes, G. W. Hough, Franklin B. Hough, Alfred Springer, Theodore G. Wormley; fellows of the association, Cleveland Abbe, Harrison Allen, William Whitman Bailey, Albert S. Bickmore, Francis Blake, Thos. T. Bouvé, H. P. Bowditch, Edw. Burgess, Lucien Carr, F. W. Clarke, A. J. Cook, W. O. Crosby, Charles R. Cross, William H. Dall, Persifor Frazer, G. Brown Goode, Asaph Hall, C. E. Hanaman, William Harkness, Edwin J. Houston, Alpheus Hyatt, B. Joy Jeffries, Gaetano Lanza, Albert R. Leeds, H. Carvill Lewis, J. A. Lintner, Garrick Mallery, W. J. McGee, C. S. Minot, Charles E. Munroe, John M. Ordway, Henry F. Osborn, Edward C. Pickering, J. W. Powell, Ira Remsen, Alfred P. Rockwell, S. H. Scudder, George M. Sternberg, P. R. Uhler, A. E. Verrill, George L. Vose, Francis A. Walker, Justin Winsor.

Probably some persons who have not received any circulars would be glad to support the movement; and we trust that any such will send their names to Dr. Minot. There has been some difficulty in reaching many persons during the vacation season; and it is known that omissions of certain addresses have unfortunately been unavoidable.

The support which the circular has received is remarkable for its extent and character, especially when its spontaneousness is considered. Most of the gentlemen upon the list given above are known as scientific investigators of acknowledged superiority, and many of them enjoy high fame; so that the plan of founding an international scientific congress meets the approval of a large proportion of those who contribute most to the dignity and importance of science in America.

— In response to an invitation sent out by the local committee of the American association for the advancement of science at Philadelphia, the following foreign scientific societies, among others, have sent the delegates mentioned to represent them at the approaching meeting in that city: Royal society, Professor Sir William Thomson, W. T. Blanford, H. W. Moseley; Royal institution, Professor James Dewar; Zoölogical society, P. L. Sclater (secretary), H. Saunders, G. E. Dobson; Royal microscopical society, Rev. W. H. Dallinger, A. W. Bennett, James Glaisher; Royal Irish academy, Prof. R. S. Ball; Royal geological society of Ireland, Professor Valentine Ball (president), Prof. W. J. Sollas; Royal Dublin society, Prof. A. C. Haddon, G. F. Fitzgerald; Royal zoölogical society of Ireland, H. M. Barton, W. E. Peebles, A. Trail; Philosophical society of Glasgow, H. Muirhead, James Mastear, Prof. J. G. McKendrick, W. C. Crawford, John Kirsop; Natural-history society of Glasgow, D. C. Glen; Royal botanical society, W. C. Crawford; Manchester literary and philosophical society, Prof. A. Milnes Marshall; Asiatic society of Bengal, Major J. Waterhouse of Calcutta; Asiatic society of Japan, Dr. D. Murray, Rev. E. W. Lyle, Perceval Lowell; Société anthropologique de Bruxelles, Dr. Victor Jacques (general secretary); Association Française pour l'avancement des sciences, Professor Joubert and Professor Silva; University of Japan (Tokio), Prof. D. Kikuchi (dean of department of science); Société entomologique de Belgique, Dr. H. A. Hagen; Ornithologischer verein in Wien, Dr. C. Hart Merriam; Royal society of Canada, a large number of delegates.

— At about five minutes past two, eastern time, on Sunday afternoon, Aug. 10, an earthquake-shock was felt along the eastern coast, from North Carolina to Maine. The direction of the motion of the wave appeared, to most who considered it, as from north to south, or north-west to south-east. The motion, as magnified at the top of the highest building in Boston, was sufficient to roll the signal-officer off his lounge. In New Jersey, where the shock was most severe, the railway-station at Seabright was shifted to one side, 'shaking up the contents.'

— The meeting this year of the German society of naturalists and physicians will be held at Magdeburg, Sept. 18–23.

SCIENCE.

FRIDAY, AUGUST 22, 1884.

'OMMENT AND CRITICISM.

ERSHIP in the American association for ancement of science is readily attain-any one willing to pay a small annual it is largely affected by the localities visits in its annual peregrination. So ections of the northern half of the States have already been visited, that ld suppose the membership would now present the distribution of interest in throughout the country; though for reasons, and particularly because the ion has never, at least in recent years, re, one would expect a feeble showing e southern and Pacific states.

nspection of the list of present mem-ows, however, some curious anomalies. al number of members is 2,011. The aving the largest number of members York (153), Boston (142), Cincinnati shington (127 each). The next high-Montreal (71), where the meeting was o years ago, which distances Philadel-1), which, in its turn, is scarcely ahead Louis (49) and Cambridge (47). New (30), with all its scientific activities, so far beyond Hartford (19) as we expect. Chicago shows a meagre num-), and is surpassed by Baltimore (28). as the nominal headquarters of the tion, hardly responds with credit (20), Minneapolis (31) surpasses Chicago ltimore. Providence (15), where the tion has not met since 1855, makes a howing than Indianapolis (7), where it 871; or Dubuque (1), 1872; or Detroit 175; or Buffalo (12), 1876. Several are surpassed by New Orleans (10), ich the association never ventured, and Francisco (6), still farther removed s activities; while Charleston, where the association met in 1850, finds no representation whatsoever.

More than one-third of the association come from New York (349) and Massachusetts (341). Ohio (208) comes next, followed by the District of Columbia (129), Canada (120), and Pennsylvania (111). No other states furnish more than 100 members; but it is unexpected to see Connecticut (73) neck and neck with Missouri (72); Rhode Island (29) far in advance of Vermont (18) and Maine (14); Michigan (25) below Minnesota (54); Kansas and Nebraska (5 each) following Colorado (9), and even New Brunswick, Alabama, Florida, Texas, and West Virginia (7 each). Kentucky (31) surpasses Iowa (25), and Indiana (39) lags far behind Illinois (69). An examination of the list on the basis of population would, no doubt, prove interesting.

How old may a newspaper be and still be a newspaper? This question has been up for decision before the secretary of the treasury, and it has been decided that a newspaper ceases to be a newspaper when it has another beside it. One newspaper is a newspaper: two or more newspapers sewed together are not newspapers, but form a book, 'at least printed matter.' All this means that a New-York importer desired, as his customers most certainly desire, that some bound volumes of periodicals should be admitted free of duty as periodicals, as, according to the last laws, the importer thought they should be. But no: the decision has come down, that "it is fair to hold it was this fresh and concurrent statement [which character it loses 'when kept for a year, and then fastened up with its fellows'] that congress meant should go free, and not (so far as news is concerned) the stale sheets, the accumulation of the year." Cannot all who may be affected, as are all readers of foreign journals, bestir themselves to prevent such needless restrictions of their rights!

The particular volumes upon which duties were called for in this case, were bound volumes of the *Annales de dermatologie* and *Annales des maladies de l'oreille*, — books which do not enter into competition with any produced in America, and which never can. If one wants a number or volume of either of these *annales*, he must have it, and nothing else will do; and no reproduction is possible, on account of the limited demand. We have, then, one more decision which interferes with American students, makes their work the more expensive, and in no possible way can benefit the American book-maker. Congress had granted a little relief, but that little has been made less by a thoughtless decision of the treasury. We say 'thoughtless;' because it is known to but few, outside those immediately interested, that the apparatus and books used by the scientific men of America *must* to a large extent be bought where they are principally produced, in Europe; reproduction being out of the question, both on account of the limited demand, and, in case of apparatus, on account of an instrument being to some extent a work of art which only one man may be capable of bringing forth.

THE great question of our time is, How shall we better our methods of education? The main efforts to this end seem to be to better the system. The real need is of better teachers, not more painstaking or devoted teachers, for in these regards there is little to be desired; but, as a class, our teachers are men and women whose opportunities of culture, whose means of obtaining a broad view of the subjects they teach, are deplorably small. Year by year the number of those who go to the teacher's work from any thing like a university training become relatively fewer. The normal school is, unfortunately, taking the place of the university as the place of training for instructors in the primary and secondary schools. These institutions are admirably contrived to serve the immediate ends they seek to attain: they make business-like but slenderly provided instructors, who do their routine work better than those bred in schools of broad learning, but who miss the best that a liberal training has to give. The normal school is fixed in our American system certainly for fifty years to come. The practical question is, What can be done to lift their work to a higher level?

There are two ways of doing this, each of which seems worthy of debate. One is to move the normal schools to the seats of good universities, and mingle the university teaching with the strictly technical instruction in pedagogics. The very presence at a university will give a lift to the ideals of the pupils in the normal school. It will cost a penny more to train the youth than it does at present, but this is not a question of pennies. Nobody reckons pennies in war; and this work of education is the eternal war of mankind. Another, cheaper, less effective, but still possibly useful plan is to give the normal-school teachers an occasional year of residence at a university, where they may for a time pursue knowledge for its own sake, and widen their views of their great work. Harvard university now allows its teachers one year in seven for private study. The state could afford to do as well by its normal-school teachers. If we lift the grade of our teachers, the 'system' will take care of itself.

THE government printing-office has recently issued a catalogue of the aquatic mammals exhibited by the national museum at the great international fisheries exhibition in London last year. It consists of a general account of the more interesting seals and whales of our coast, with a briefly annotated list of all the species exhibited, and is prepared by Mr. F. W. True. It detracts very much from its value that it was not printed, and ready for sale or distribution, at the time of the exhibition. To appear now, when the collection is shipped to another continent, seems somewhat of a farce, as its whole value now lies in what it contains *apart* from the collection. Either we should revise our dilatory, and at the end hasty, legislation in

itters, or the exhibiting departments of
ernment will be forced to the necessity
proper credit to themselves) of main-
exhibition series, which, with slight
ations for special occasions, may be
hand, to send wherever and whenever
l. If we are rightly informed, the na-
museum has already decided on some
ep; and, if international exhibitions are
yearly occurrence, the museum should
its staff a special exhibitionary force,
t weaken its efficiency for its proper
y these constant extra draughts upon
gy.

LETTERS TO THE EDITOR.

Classification of the Mollusca.

r. Dall's kindly notice of the article 'Mol-
n the 'Encyclopaedia Britannica,' published
journal of June 13, he attributes to me "the
us statement that the radula of Glossophora
r," and adds that 'it is really chitinous.' In
inary sense of the word 'horny,' chitin is (I
to think) correctly described as horny. That
ula is generally considered to consist of the
l body known as chitin is distinctly stated in
cle criticised by Mr. Dall. At the bottom of
ccur the words, 'a chitinous band (the rad-
I should be glad to know if Mr. Dall has
ken any special chemical analysis of the sub-
f the radula (1).

regard to the very general presence of jaws
ophorous Mollusca, I must maintain my state-
The presence of a calcareous impregnation is,
e, not usual, but exceptional (2).

Dall is mistaken in supposing that I have fol-
Macdonald in regard to formulae for the teeth
radula. The other writers whom he cites as
owed are precisely those from whom my state-
n the details of this subject were drawn (3).

e no fault to find with Mr. Dall for differing
e as to certain points of classification, but I
be glad to know his *grounds* for regarding the
anchia as an artificial group. He merely re-
the old view, which I think I have sufficiently
to be untenable (4). Mr. Dall also asserts
e orders of Lipocephala, based on the charac-
he adductor muscles, are defunct. In spite of
inion, the muscles themselves still exist, and,
opinion, furnish indications of natural and
nt divergent groups among the bivalves (5).
uld be glad to know on what grounds Mr. Dall
rs the three divisions of Lipocephala adopted
o be unnatural.

y, let me say that I do not know on what
ty Mr. Dall asserts that the calcareous devel-
s of the integument in Chaetoderma and Neo-
have no relation to the shells of Chiton. That
so represent or replace the spines of Chitons
iently obvious. But what is to prevent our
ing of the epidermic shelly plate of a Chiton
nally developed by the gradual coalescence of
er of small calcareous denticles, in the same
way as the mesodermic dermal bones of bony fishes have developed from the shagreen denticles of the sharks (6)?

E. RAY LANKESTER.

University college, London,
July 23.

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(1) Not being an organic chemist, I have not attempted analyses, but have tested many radulae with one result, — the cutting points of the teeth are always, and the whole radula generally, of a substance allied to chitin. The very generally erroneous statements in the text-books led to the criticism of the language of Professor Lankester as tending to continue the confusion. Chitin is surely as different chemically from horn as bone is, and it cannot be desirable to continue to treat the two substances in a way to perpetuate an error. Further data on this topic may be found in the August *Naturalist*, pp. 776–778.

(2) I should be grateful to Professor Lankester for the name of any recent mollusk having a 'shelly' or even a partially 'calcified' jaw.

(3) The formulae given for the teeth, and the method used in making a formula, as inferred from the text, which were the particular details criticised, are partly incorrect. I was wrong, however, in assigning a source to them. One (for instance, Patella vulgata) has the formula 3+3+1+3+3, instead of 3.1.4.1.3. No mollusk has more than one median tooth; and the central figure of the formula must in all cases be 1 or 0. I find the erroneous formula in Sars's text, though he figures the teeth correctly. Again: Chiton stelleri has, like all Chitons hitherto examined, the formula 6+2+1+2+6, instead of 0000.1.1.1.0000, which is given; but this is doubtless copied from some other authority. However, accurate formulae for the Chitons and Limpets have been accessible for some years. Again: the teeth of the radula are divided by nearly all modern students of that organ into rhachidian or median, lateral, and uncinal teeth, — three series which have anatomical relations to the radula, which are usually pretty clear. For 'lateral' Professor Lankester substitutes the term 'admedian,' which is not, as far as I know, in use; and for the 'uncini' he adopts the term 'laterals,' which I venture to think is undesirable as leading to confusion, and not in accord with general usage.

(4) The grounds on which I sustain the generally accepted views of malacologists, as to the relations of the groups Professor Lankester has compounded into the order Zygobranchia, are, that the mere abortion of one of a pair of organs is not a character of ordinal value; nor are the characters assigned to Zygobranchia applicable to all its members. Moreover, I am of the opinion that the characters which unite the Rhipidoglossa among themselves and the Docoglossa among themselves are of higher systematic value than the characters here relied upon for dismembering them. I believe, that, had the learned professor made researches among a large number of these forms, he would probably be of this opinion also.

(5) The characters of the adductor muscles, as long as we were ignorant of intermediate forms, seemed to afford a good basis for orders in the Lipocephala. Now that we know of forms which are more or less intermediate, in the Pectinidae, Ostraeidae, Mytilidae, and other families, and that in the young (not embryonic) there are frequently two adductors discernible in supposed monomyarians, with such forms turning up as Dimya, and, more recently, Chlamydoconcha, all tending to efface the supposed definite limits between the alleged orders, it seems impos-

sible to retain these orders any longer. Stoliczka came to this view long ago, and much corroborative evidence has come to hand since. In fact, there does not at present seem to be any good basis for ordinal divisions in the Lipocephala. The divisions adopted by Professor Lankester are not unnatural; but they appear to have merely an approximate value, and shade into one another to such an extent as to be of little systematic use.

(6) There is nothing to prevent any such conception; but, unfortunately, there is no evidence, as yet, that it would conform to any subjective reality. A parallel statement would be, that the wool on a ewe 'replaces' the horns on a ram. We can conceive that woolly or hairy secretions may be so modified as to produce horns, and, in fact, do produce them occasionally. The importance of the shell-gland in the embryonic condition of the Mollusca, as shown by Professor Lankester, than whom none have contributed more valuable investigations on this topic, forbids that we should consider these secondary cuticular products as its equivalent. That they are nothing less than identical with Chiton spines will, I think, be admitted by any one who compares the figures of Reincke and Hubrecht on Chitons and Neomenia respectively. There are also a great variety of other Chiton spines; and on some Fissurellidae, and even in some brachiopods, analogous structures may be found.

In conclusion, Mr. Editor, permit me to express the hope that these more or less unimportant defects in detail, which are inevitable to all work of a general character, may not obscure what I have endeavored to state clearly (namely, the great value and usefulness of Professor Lankester's work), nor delay what I believe will be its eventual consequence, — an important reformation in our general molluscan systems.

W. H. Dall.

The earthquake of Aug. 10.

It is a little remarkable that the earthquake-shock of yesterday should have been felt with considerable force in the city of New Haven, which is built upon a sandy plain, while it was perceptible only as a short series of lateral vibrations, lasting about a second and a half, and so slight that it was unnoticed by most persons in the vicinity of the observatory. The observatory is built on a sandstone ledge, and is about a hundred and fifty feet above tide-water, in (geodetic) longitude west 72° 55′ 19.15″, and latitude north 41° 19′ 28.48″.

At the time of the vibration the writer was sitting at a table, and its probable origin at once occurred to him. Allowing for the few seconds occupied in taking out his watch, the tremor occurred at 2 h. 7 m. 25 s.; and, as the watch at that time was 1.5 s. slow of the fifth hour west from Greenwich local mean time, the tremor may be set down as beginning at 2 h. 7 m. 27 s. by this mean time; and I should estimate the uncertainty at not more than 2 s.

Leonard Waldo.

Yale college observatory, Aug 11.

On Sunday, Aug. 10, at 2 h. 8 m., I felt an earthquake, lasting three or four seconds. The oscillatory movement was from a little south of west, toward a little north of east. The oscillations were rapid but slight, with maximum intensity between the first and second second, when the movement began gradually to decrease. The accompanying sound was like the rumble of artillery-wagons. Jules Marcou.

Cambridge, Aug. 10.

EPIDEMIC CHOLERA AND INFECTIOUS DISEASES.

The presence of cholera this summer in epidemic form in southern France, the appearance of sporadic cases at widely scattered places and on shipboard at various seaports of the European continent and of England, have brought western civilization once more face to face with two of the most important problems which modern science and social organization can be called upon to solve. These problems just now come home to every one, but in ordinary years are put out of mind, or left to the care of laboratory devotees, or of officials charged with departments concerned with public hygiene.

The first involves a purely scientific question as to the causes, modes of origin, and ways of propagation, of the infectious or so-called zymotic diseases: the second, evolving itself naturally from the first, is of a more immediately practical nature, and deals with the processes best calculated to prevent and antagonize these diseases, especially when presenting themselves as epidemics. And these problems owe this much to such epidemics, — that by them men as individuals, and governments (their representatives), are stimulated to a vigor of inquiry and action which are never evoked by a customary rate of mortality, however high, from endemic diseases, such as are always with us; just as the stimulus of prospective want often meets with a ready response where chronic destitution makes an ineffectual appeal to action. Typhoid-fever, resembling cholera very much in its propagation, demands a steady toll from the populations of Europe and North America, compared to which the occasional ravages of cholera become insignificant; and yet it is impossible to inspire them with an intelligent dread of that enemy expressing itself in possible and comparatively simple precautions. The self-reliant Anglo-Saxon continues to regard typhoid-fever with a measure of the same indifference felt by the fatalist of India toward cholera; and the explanation is to be found,

we believe, largely in association, and not merely in the fact that fifty per cent of those attacked with the latter disease die, whereas about eighty-five per cent of typhoid-fever cases survive. The typhoid sufferer, as a survivor even, is robbed far more ruthlessly of time and strength, which by the Anglo-Saxon are transformed into wealth, which to him is life.

By this seeming digression we would impress upon readers, begging them to keep it steadily before themselves and their public authorities, the fact that cholera is but one form under which these great general problems of the cause and prevention of infectious diseases present themselves. The prevalence of cholera in France gives the health evangelist in the United States, who might otherwise continue crying in the wilderness, at once a text and a hearing, from which those who have come out from their usual routine must not be allowed to depart without a resolve to amend their ways, even though they escape this especial visitation. This threatening of cholera should be the spur to animate northern zeal for the solution of these problems which the south so often finds in the proximity of yellow-fever.

It now seems quite possible that the United States may escape, at least this year, an invasion of epidemic cholera; but if so, the reprieve should be used to perfect precautions and vigilance against next year, and to collate, as far as may be, the latest scientific investigations with previous observation and experience. *Science* has already published, either in full or in abstract, the seven reports to the German government emanating from the cholera commission under Dr. Koch in Egypt and in India. These, in giving in a somewhat popular form the results of studies of the fresh excreta of forty cholera patients and of the cadavers of fifty-two recent victims, offer an interesting and doubtless valuable contribution to the subject under discussion, but by no means demonstrate that the active principle of cholera resides in a microbion, or that the particular microbion has been discovered.

Notwithstanding the labors and advances in this direction during the last ten or twelve years, the number of diseases in regard to which a positive affirmation can be made that they are caused by a micro-organism, and by a specific micro-organism, is still very small, and neither cholera nor typhoid-fever can as yet be included in that number. The number in regard to which there is only a strong probability that they result from a specific germ, propagating amid favorable surroundings, and finding entrance to the system of the victim under favorable circumstances, is much larger, and must still be regarded as embracing cholera.

The investigations of the German commission will probably be continued under the auspices of the German health bureau at Berlin, or otherwise; and the British government has at last appointed a commission, consisting of Drs. Klein and Heneage Gibbes, to go to India and pursue this inquiry as to the nature of cholera: so that a further elucidation of the subject, and of the precise significance of Koch's observations, may reasonably be anticipated at no distant day. In the mean time it is our duty to protest against a confident application to the disease itself of measures of prophylaxis, of treatment, of disinfection, or of quarantine, based upon the life-history of the *comma-tipped bacillus*, or upon its behavior when subjected to the action of certain media or of certain germicides.

Although their specific microbions have not been definitely demonstrated, experience and observation have fairly established the probable accuracy of certain views in regard to both typhoid-fever and cholera; and upon these the measures to be adopted against such maladies are at present to be based. They are clearly and concisely set forth in a circular entitled 'Suggestions relative to epidemic cholera,' lately issued by the Massachusetts board of health, itself following generally a previous circular emanating a year ago last June from the English local government board, and reprinted under the same authority, with other supporting papers, last July.

AMERICAN APPLIANCES FOR DEEP-SEA INVESTIGATION.—THE DREDGES.

THE use of dredges for obtaining marine specimens is said to have been suggested by the common oyster-dredge, — a one-sided contrivance, well adapted for the shallow oyster-banks, on which it is skilfully handled by the oyster-fishermen of both Europe and America. This dredge possesses only a single narrow, hoe-like, scraping edge, attached to a light frame above, furnished with rigid handles. The net has a coarse mesh of stout twine, or small interlacing iron rings, the two materials being often combined. This net is too coarse to retain the finer objects, which are as important to the naturalist as the larger; and in even moderate depths there is constant danger of the frame capsizing in its descent through the water.

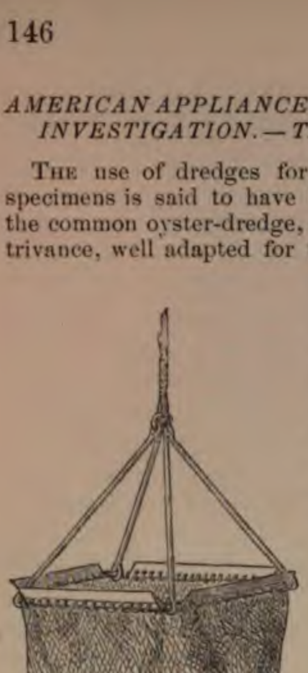


FIG. 1.—OTHO FREDERICK MÜLLER'S DREDGE, A.D. 1750.
(*From 'The depths of the sea,' p. 239.*)

It was these imperfections in the oyster-dredges, unsuiting them for careful work, that led to the changes in the shape of the frame and in the construction of the net, resulting in the production of the perfect yet simple appliance which is now used with as much precision in the deepest parts of the ocean as is the oyster-dredge in its few fathoms of water.

The ordinary dredge.

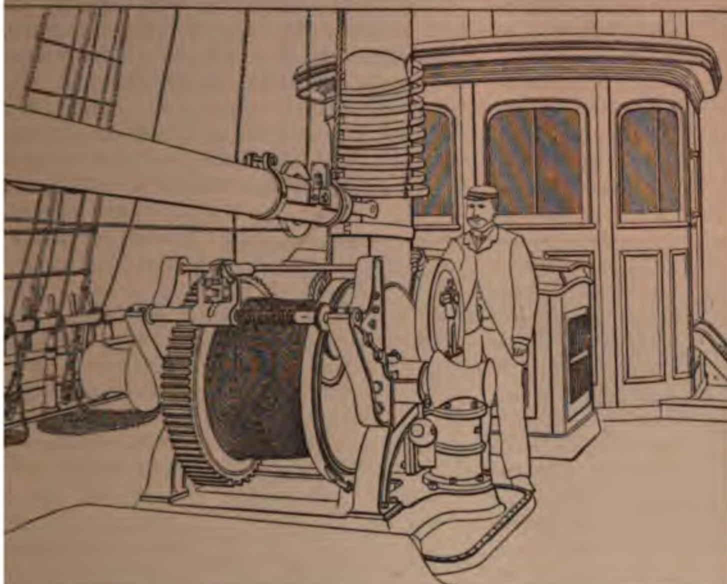
The dredges adopted by the U. S. fish-commission in 1871, and still employed for all ordinary kinds of work, are of the Ball pattern, but slightly modified. The same pattern has also been used to some extent by the U. S. coast-survey.

The fish-commission dredges are made in two sizes, — the smaller, called the 'boat-dredge,' being suitable for moderate depths of water from small boats, where only hand-power is available for the hauling-in; and the larger, termed the 'deep-sea dredge,' for vessels supplied with steam-hoisting engines. Otherwise than in size, however, these two dredges do not differ from one another. In the deep-sea pattern (fig. 2), the mouth-frame, which is constructed of the best quality of wrought-iron, measures two feet long by five and a half or six inches wide between the hinder edges of the scrapers which form the longer sides of the frame. The latter are two and three-fourths inches wide and a half-inch thick, being bevelled to a sharp edge in front, and are joined to the rounded end-pieces at an obtuse angle, which causes them to flare forward, — an essential feature for most kinds of dredging-work in which it is required that the scrapers should have a strong tendency to dig into, or 'nip,' the bottom. The handles are of round iron, bent double, as shown in the figure, with a loop at the outer end for the attachment of the drag-rope, the lower ends making a single turn about the end-pieces of the frame, upon which the handles move freely.

FIG. 2.—THE NATURALISTS' DEEP-SEA DREDGE AS RIGGED BY THE U. S. FISH-COMMISSION.

The net is either a closed bag of strong twine netting, having a finer mesh at the bottom than at the sides, or is made cylindrical in shape, of webbing having three or four meshes to the linear inch, the lower end being tied with a stout cord when in use. To protect the net from wear on rough bottoms, and prevent its bursting open when heavily loaded, it is covered with a bottomless canvas bag a few inches longer than the net itself. To the lower end of this bag and to the end of the net a small round stick is fastened. This is intended to prevent the fouling of the net while being lowered, and also to aid in reversing and emptying it after it has been hauled back upon the deck. It is purposely made of soft wood, in order that it may break without tearing the net if it becomes caught upon the bottom.

e drag-rope proper is tied directly to one le only, but is connected with the other



. — THE HOISTING AND REELING ENGINE OF THE U. S. FISH-COMMISSION STEAMER FISH K, SHOWING THE SUPPLY OF WIRE ROPE COILED UPON THE DRUM. VIEW FROM FOR-D, LOOKING AFT.

neans of a rope uch smaller size, h, in case of foul-on rocky bottom, e the first to part, ling the dredge to rought up side-, a not unfrequent rence.

ch, in brief, is onstruction of the important dredg-ppliance of the and one which undoubtedly be nued in use as as marine explo-ns are carried on. all the ordinary oses of dredging, ially in moderate s of water, it an-s every require-; its flaring mouth ng it to dig slight-o sandy and mud-ottoms which are not too soft, and to e thoroughly over those of rock when not too ragged. It is also cheaply constructed, and therefore within the means of private individuals.

The dredges used by the English Porcupine and Challenger expeditions were of the same pattern, though somewhat more complicated in construction, and much larger and heavier. Judging from the reports of Sir Wyville Thomson, we are also led to believe that they gave much less satisfaction than our own; and, although many of their apparent faults were acknowledged by the director in his 'Depths of the sea,' no very great improvements are noted in the narrative of the Challenger voyage. All of the changes made by these two important expeditions were apparently in the direction of increasing or lessening the

FIG. 4. — THE FORWARD DECK OF THE U. S. FISH-COMMISSION STEAMER FISH HAWK, LOOKING FORWARD FROM THE PILOT-HOUSE, SHOWING THE HOISTING AND REELING ENGINE AND THE DREDGING-BOOM.

weight of the frame, and varying its proportions of length and breadth, the same general shape being always retained. The handles were modified in different ways, and several tangle-swabs were generally attached to the hinder end of the bag.

The Porcupine dredges weighed from a hundred and fifty to two hundred and twenty-five pounds, and the frames were in some cases four and a half feet long. Discussing their merits, Sir Wyville Thomson states, that in many instances he had evidence "that the dredge, instead of falling upon the surface, and then gliding along and gathering the loose things in its path, has fallen upon its mouth, and dug into the tenacious mud, thereby clogging itself so as to admit but little more. I mean to try the experiment of heavier weights and lighter dredge-frames in the Challenger, and I believe it will be an improvement."

It was the fault here mentioned that suggested the construction of the Blake dredge described below, and which is now used by both the coast-survey and fish-commission for the muddy bottoms of deep water.

The Challenger dredge (fig. 6), as figured in the first volume of 'The Atlantic,' was an elaborate affair; and much rigidity was given to the entire appliance by two iron bars extending back, one on either side, from the mouth-frame to an iron crossbar behind the net. This cross-bar afforded attachment for tangle-swabs and weights, when such were desirable; but its main object, in connection with the lateral bars and three loopings about the net, was to keep the latter distended, and prevent its folding over the mouth of the dredge.

FIG. 5.—THE DREDGING ARRANGEMENTS AT THE STERN OF THE BRITISH SHIP PORCUPINE, SHOWING THE ACCUMULATOR, THE DREDGE, AND THE MODE OF STOWING THE ROPE ON THE 'AUNT SALLIES.'

(*From 'The depths of the sea,' p. 248.*)

We might almost be led to consider that in this device we have a faint suggestion of the more recently invented Blake dredge; yet the two differ radically in construction, and no hint is given, in connection with the former, that a framework might be so constructed as to prevent the undue digging-in of the mouth-scrapers. The dredges used by the Challenger for all excepting the greatest depths were no smaller than those of the Porcupine; the length of the frame being the same as that above given, and the width much greater (fifteen inches).

The Blake dredge.

The difficulty of obtaining good results with the common dredge, on the soft bottoms of mud and ooze which characterize the deeper waters off shore, gave rise to many experiments on the steamer Blake during her first dredging-cruise (1877–78), resulting in the construction of an entirely new pattern (fig. 7), well adapted to this kind of work. The necessity for a change in this direction is well expressed in the above quotation from Sir Wyville Thomson. The whole tendency of the flaring mouth, with so shallow a frame, is to work downwards as well as forwards; though in moderate depths this tendency may be more or less counteracted by a careful manipulation of the drag-rope. The dredge becomes clogged, and its farther progress is of no avail in collecting the objects which live upon the surface of the mud.

The first remedy tried was applied directly to the ordinary dredge, and consisted in 'stopping' a piece of two-and-a-half-inch rope around the hinder part of the frame, thereby correcting to a certain extent the unfavorable

[...]s of the scrapers, raising their lips, and [...]nting their cutting so deeply into the [...]. Better results were thus obtained; but

FIG. 6.—THE CHALLENGER'S DREDGE.
(From 'The Atlantic.')

[...]tter ones followed the completion of the [...]rame, which was soon afterwards con[...]ed, and used during the remainder of [...]uises.

[...] Blake dredge, as it is called, was devised [...]mmander Sigsbee, U.S.N., and Master [...]y, U.S.N.; the "object sought in the [...]ning of the new dredge" having been, [...]ling to the account of Mr. Sigsbee, "to [...]a skimming of the bottom rather than a deep penetration therein." Its essential features (as shown in fig. 7) are its broad, non-flaring scrapers, and rectangular iron frame or 'skeleton box' outlining its entire shape, the entire framework being rigidly joined together. These cause it to rest flat upon the bottom, and prevent its digging in beyond a slight depth. The small quantity of mud which enters at a time is being constantly washed from the net, to a greater or less extent, by the force of the water passing through it, leaving only the coarser portions and the specimens behind. When a sample of the fine bottom-material is desired, the lower part of the net is lined with some open-mesh cloth, like muslin or scrim.

The length of the frame is about four feet, the width about three feet, and the depth nine inches. The scrapers are six inches wide and three-fourths of an inch thick, being bevelled on the inner faces at the front to form sharp edges. The net, constructed of twine webbing, hangs loosely within the frame, over which a canvas covering is fastened for its protection. As used by the Blake, a transverse bar of wood or iron, for the attachment of weights and tangles, was secured to three sister-hooks at the hinder end of the frame.

This form of dredge has since been adopted by the fish-commission for deep-sea explorations, and often replaces the simple frame and net used in connection with the Chester rake-dredge described below.

FIG. 7.—FIRST FORM OF THE BLAKE DREDGE.
(From Sigsbee's 'Deep-sea sounding.')

Rake-dredges.

In 1871 Prof. A. E. Verrill, in immediate charge of the dredging operations of the U. S. fish-commission, conceived the idea of supplementing the work of the common dredge by the

use of a greatly modified form, called the rake-dredge, the object of which is to dig deeply into

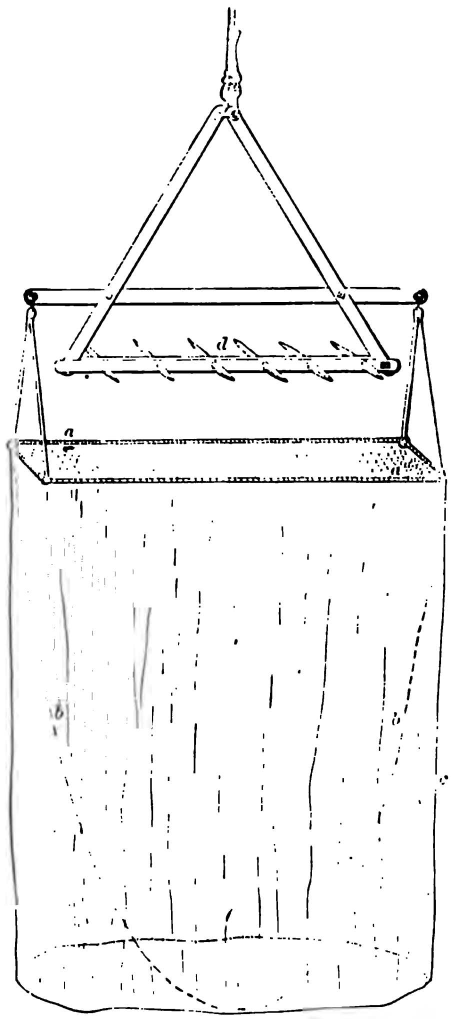


FIG. 8.—VERRILL'S RAKE-DREDGE.

the bottom, and unearth the many burrowing forms of marine invertebrates which are rarely taken in the old pattern.

This apparatus consists of a triangular frame of flat-bar iron, each side measuring forty-two inches in length. The hinder portion of the frame, which is three feet long, is constructed of two bars placed face to face, each furnished with six strong iron or steel teeth, about a foot in length, on opposite sides. These teeth, therefore, project in opposite directions; and the frame is reversible in use, working either side down. It is also so bolted together that it can be folded up for convenience in transportation. From a crossbar near the hinder end of the frame, there is suspended a capacious net, which trails behind. The mouth-frame of this net is made of round iron.

This implement, therefore, consists essentially of a large dredge, not furnished with scrapers, but preceded by a stout rake or harrow. The character of the work which it is intended to perform is obvious, and the many interesting forms which it has added to the collections of the fish-commission have caused it to be considered one of the most important additions to the dredger's outfit. It can, however, be used only on smooth muddy or sandy bottoms, and requires considerable force to drag it through compact mud or sand.

The same form of rake-dredge, without alteration or improvement, was adopted by the French exploring-steamer Talisman in 1883.

Capt. H. C. Chester of the fish-commission party devised, in 1880, a new form of rake-dredge (fig. 9), which is now generally employed in place of the old pattern. The net is similar to the one above described; but the rake consists of a heavy rectangular frame of flat iron, along the opposite and longer sides of which the teeth are arranged, projecting outwards. The rake-frame measures three feet long by nine inches wide; and the teeth are about eight inches long, stout, curved, and pointed.

The principal improvement claimed consists in separating the two rows of teeth so that the upper row may not interfere with passage backward into the net of the larger objects dug up by the lower teeth as they scrape along the bottom.

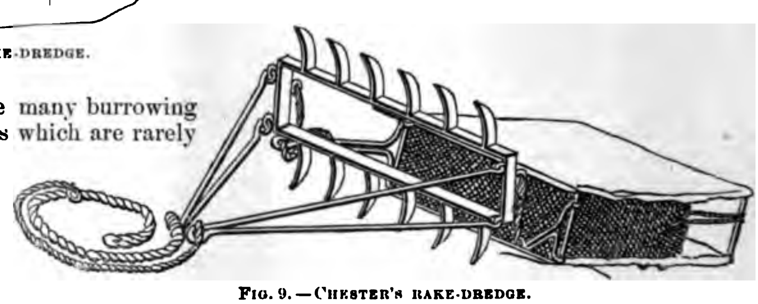


FIG. 9.—CHESTER'S RAKE-DREDGE.

An ingenious pattern of rake-dredge, intended for collecting small forms of invertebrates in shallow water, was invented in 1880 by Mr. James E. Benedict of the same party. As represented in fig. 10, it consists of a double

rake, and a cylinder of galvanized sheet-iron, thirty inches long by eleven inches in diameter, containing an elongate, tapering strainer, and supported in an iron framework having six runners of round iron at equal distances apart. The mouth is furnished with a short conical strainer of coarse wire netting projecting from the front, and a funnel-shaped collar of sheet-iron opening inwards. This dredge is designed for collecting the small, unattached forms of marine animals living upon smooth bottoms,

FIG. 10.—BENEDICT'S RAKE-DREDGE.

which are crushed or lost sight of in the ordinary dredges and trawls. The rake is intended to give the bottom-materials a thorough stirring up, so as to dislodge the animals, which, together with the sediment, come in contact with the nose-piece of the cylinder, only those below a certain size being able to pass in. This appliance has proved very effective in collecting in perfect condition many delicate species of animals which had previously been seldom obtained in suitable shape for study, and at the recent London fisheries exhibition it elicited much favorable comment from European naturalists.

RICHARD RATHBUN.

THE ORIGIN OF THE OHIO MOUNDS.

The mounds of the Mississippi valley historically considered. By LUCIEN CARR, assistant curator of the Peabody museum of American archaeology. [From vol. ii. of the *Memoirs of the Kentucky geological survey.* N. S. Shaler, director.] 1883. 100 p. 4°.

THE thesis which Mr. Carr has to defend in this elaborate paper is that the red Indian, as he is known historically, and without implying any lapse from a higher condition of life than he now occupies, was quite capable of building the mounds of the Mississippi valley. As we have no positive proof of what the people were who did build them, and no record of the time of building, except inferentially in some cases from the rings of trees, he claims that there is no necessity of supposing them the work of other folk than those found upon the spot by the whites at the first contact. Further, should, by any chance, evidence be found hereafter to fix the so-called mound-builder as another race, there is no ground to believe them to be higher in the social scale than the red Indian of historic times. He admits that in size the Ohio mounds, in some cases, exceed those which the Indian is actually known to have built in recent times; but in his opinion the difference is one of degree, not of kind, and accordingly weighs little in the discussion. To establish his ground, Mr. Carr meets the objections to it historically. It is urged that a people like our modern Indians could not have built the mounds, because they were followers of the chase, and not agriculturists; and without being agriculturists they could not have supplied the subsistence for the large number of men necessary to erect these mounds. There are two ways of answering this proposition. One is by asserting that there is no evidence that the building was done in such a way as to require much labor in a short time; while it may be believed that the labor was extended over a long time, and hence required few workers at any one time. This answer Mr. Carr ignores. The other reply is, that it is an unfounded assumption to affirm that the red Indian was not an agriculturist, when it is susceptible of proof that he not only supplied from the fields daily wants, but laid in store for unfruitful years and for barter. This position Mr. Carr abundantly sustains from the older writers.

The second proposition which he meets sets forth the so-called mound-builders as worshippers of the sun, and their structures as inferentially allied with that cult; while the Indian is not and was not such a worshipper. His answer to this is, that the red Indian is, and particularly was, a sun-worshipper; and this he establishes satisfactorily from the early chroniclers. Further, it is a mere assumption, in his opinion, to call a certain class of these mounds religious while there is no proof of it. The truth seems to be, that designations of convenience have grown to be arguments obscuring the question.

Having thus in two sections of his paper proved that the Indian could have built such

works if he would, Mr. Carr next undertakes to show that the Indian is known within historic times to have built similar though smaller works. Arraying a mass of testimony from the old and even later writers, sufficient in quality and quantity, he succeeds in doing this.

There is one natural objection to his conclusion. While some, or most it may be, of existing mounds should be traced to early generations of the red Indian, or of races on his plane, he does not admit that it is supposable that another race, possibly of higher grade, may have built other of the mounds.

We suspect that the truth of this last proposition is to rest on other investigations than Mr. Carr has yet touched. Manifestly, that the Indian could have built the mounds does not prove that he did; and, even if it be proved that some of the mounds in question can be directly traced to him, it does not follow that others may not have been built by a different people, since mound-building cannot be confined historically to any single people or any single continent.

Perhaps Mr. Carr has thrown the burden of proof upon the opposers of his theory, since it may be fair to argue that there is no necessity of supposing another race to account for the mounds. Granting that Mr. Carr establishes his point from the external evidences of the mounds, there yet remains a test for his theory in the contents of the mounds. Mr. Carr acknowledges this shortcoming of his argument, and promises in due time to examine the question from the testimony of the skulls and relics of workmanship, as well as from evidences of parallel custom, which can be drawn from the records of the exploration of the mounds. These, it seems to us, are to be the final tests. It is clear that history cannot settle the question, but archeological investigations may. We suspect that Mr. Carr wrongly estimates the comparative value of the two methods in a question of this kind. He says that the investigators who have given rise to the views which he combats have been "practical explorers, who have brought to the investigation a certain number of facts, chiefly cumulative in character, and who have not as a rule been possessed of that measure of historical information which is necessary to a correct interpretation of these facts." It is indisputable that the historical evidence accumulated by Mr. Carr may be helpful; but the fact still remains, that this evidence must be viewed in the light of the archeological results. It may be safe to grant all that these historical evidences prove; but arguments respecting the origin of the mounds, based on them, become inferential, and may or may not accord with the archeological demonstrations. There can be no question which is to be the ultimate tribunal.

SIDGWICK ON FALLACIES.

Fallacies: a view of logic from the practical side. By ALFRED SIDGWICK, Berkeley fellow of the Owens college, Manchester. New York, *Appleton*, 1884. (International scientific series.) 16+375 p. 16°.

IT does not often fall to the lot of a reviewer to find so little to praise in a book by so clever a writer and clear-headed a logician as the author of the treatise on fallacies, which has appeared in the International scientific series. What most obviously calls for complaint is its want of adaptation to the main purpose for which, by its publication in this series, and by the explicit avowal of the author in his preface, it seems to have been designed; namely, to be of profit to the general reader. No reader who has not become familiar with the technical language of logicians, and even with many phases of logical controversy, is at all likely to follow our author with sufficient interest to so much as comprehend what he is talking about, much less to carry away a clear and lasting impression of important truths. Not that much knowledge of logic is presupposed; but the discussion is so full of abstractions and subtleties, of nice distinctions which we are presently told are no distinctions at all, and identifications of things we had supposed very unlike and which we are presently told we would better keep apart as of old, that if we add to the intangibility of such questions the difficulty, for novices in logic, of promptly seizing the precise force of the terms which are necessarily employed, we cannot expect any very valuable results from their perusal of the book before us.

But, in point of fact, it is not to tyros only that the book will be a disappointment. There is much balancing of views on nice points of language, and every now and then a most refreshing bit of sarcasm, for our author has a keen eye for all sorts of logical weakness; and there is often plain talk about the practical limitations to which we are subject in the search for truth. But there is an extraordinary absence of decision and concentrated statement, — qualities indispensable to the success of a work of this kind. On almost every point the author comes to the conclusion that little or nothing which is useful can be said about it. With

this conclusion we are not prepared to express a disagreement; but we feel quite convinced of the unprofitableness of reading three or four hundred pages of particularly uninteresting matter to arrive at it.

There are two reasons why it seems especially ungracious to speak so slightingly of the value of Mr. Sidgwick's book. In the first place, almost every page bears evidence of the author's logical power and literary cleverness; and many passages are really good and valuable. There is an excellent chapter on the burden of proof; the remarks on the variation in the meaning of words, and many other detached discussions, are admirable; and the author is always refreshingly severe on the subject of baseless metaphysical speculation. It is pleasant, too, to come upon such human, unscholastic ways of putting things as we are frequently treated to. Thus, on p. 128: —

"For, besides the real danger of platitude, there is an opposite danger to be avoided; namely, that of unduly and vexatiously stopping an argument to have the terms explained. Without wishing exactly to defend those who made Socrates drink poison, one still cannot help recognizing that there is a limit, beyond which the laudable desire for definiteness loses its value, and becomes a hindrance and a snare. There is something so fatally easy in the attitude of a sceptic or mere questioner. Any child can keep demanding explanations, any man sufficiently stubborn can delay the most important truth by pretending not to understand its import. An obstructive policy of this kind requires no great intellectual power; and, when adopted solely for obstructive purposes, it demands, as much as any thing, a rule of urgency. Life is not long enough for exhaustive explanations."

And on p. 289: —

"Nothing could well be more confusing than an attempt to apply the cumbrous machinery of the syllogism to arguments met with in real life. And whoever has tampered with his mother-wit by substituting for it a clumsy logic depending on elaborate mnemonics, must, no doubt, pay the penalty in loss of power, so long as the mischief remains."

In speaking of the methods of induction, as stated by Mill, the author judiciously remarks, —

"Since there may possibly be, in some quarters, a disposition to take these methods for more than they were probably intended to be worth, there will perhaps be some use in reminding the reader that it is the guarding against the danger to which each method is liable, that is in every case the all-important circumstance, far more so than the mere employment of this or the other method."

And a clever hit is made in introducing these methods: —

"While, as their author himself (and more lately, Professor Jevons) expended labor in showing, none of these is, except in an ideal sense, completely satisfactory" . . .

The other reason for one's dislike to condemn the book as a whole is, that the author's faults are so largely the *défauts de ses qualités.* His mind is so open to every argument that can be urged on either side of a question, that he finds it much harder than ordinary mortals do to come to a decision; and he is so conscientious in his attempt to tell the reader the whole truth, that he gives some measure of approval to any view that has the least proportion of truth in it. This scrupulousness is most annoying and obstructive when he deals with the definitions of his terms. Here we have to watch a long process of painful labor, sometimes over very simple matters, almost always with very little result. It is, of course, a vulgar error to suppose that a scientific definition ought to be so framed that no doubt can arise as to any individual case being comprehended under it. Scientific men well understand by this time, that, however we may frame our definition, there will always be a strip, more or less narrow, of debatable ground along the boundary. But Mr. Sidgwick is alone, we may hope, in going a step farther, and carefully making his boundary run in such a way that the debatable ground shall be co-extensive with the whole territory. This peculiar excess of refinement, which so often interferes with the effectiveness of our author's work, strongly reminds one of two recent important works on ethics and economics, and almost demands the coining of the adjective 'Sidgwickian' to describe it.

Of logical errors there are few, if any, in the book; but the author occasionally illustrates his own doctrine of the difficulty of establishing a charge of fallacy, due to one's inability to know how a given argument was intended to be understood by its proposer. Thus, in the quotation discussed on p. 259, *et seq.*, we can but regard the criticism as captious. If the passage is an example of false analogy at all, it is so in a very mild degree; nor are the two examples on p. 264 strikingly in point, if at all. And this leads us to mention one final criticism on the work, in so far as it is intended to be practically useful. There are very few illustrative examples, and a notable absence of any discussion of the fallacies which have actually played a part in the history of intellectual progress. The author does not familiarize the reader with the dangers of fallacious reasoning by concrete instances, or stimulate his interest by pointed discussions involving the applications of principles rather than the principles themselves. It would be time to write a book in the spirit of this one, when everybody had

become as good a scientific thinker as Faraday or Darwin; but to-day, while fallacies of the crudest kind are rampant in every field of discussion, from religion and party-politics to biology and political economy, something less ethereal and impalpable than this statement of the necessity of philosophic doubt would have been far more useful.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of natural sciences, Philadelphia.

July 8. — Professor Angelo Heilprin described a new trilobite from Walpack Ridge, about ten miles north of the Delaware Water-Gap. The tail-piece, which was the only part of the animal found, indicated an individual some six or seven inches or more in length, and clearly demonstrated its relationship to the genus Phacops, sub-genus Dalmania. Among its faunal associates were Phacops Logani, P. (Dalmania) pleuroptyx, Acidaspis tubercularus, Spirifer macropleura, Atrypa reticularis, Strophomena punctulifera, S. rhomboidalis, Orthis subcarinata (or O. multistriata ?), Merista sp., etc. The horizon is that known as the Stormville shales (lower Helderberg), evidently the equivalent of the Delthyris shales of the New-York geologists.

Philosophical society, Washington.

April 26. — Prof. J. R. Eastman reported the discovery of a mass of meteoric iron at Grand Rapids, Mich. An analysis by Dr. F. W. Taylor gave: iron, 94.54; nickel, 3.81; cobalt, 2.40; insoluble, about .10; total, 100.85; specific gravity, 7.53. —— Mr. William H. Dall read a paper entitled 'Certain appendages of the Mollusca.' —— Mr. J. S. Diller read a communication on the volcanic sand which fell at Unalashka, Oct. 20, 1883, and some considerations concerning its composition. The substance of this communication has already appeared in *Science*. There ensued a general discussion of the nature and properties of volcanic dust, and of the theory which ascribes recent peculiar meteorologic phenomena to the dust ejected from Krakatoa. Capt. C. E. Dutton argued that the formation of volcanic dust particles by the bursting of bubbles tends to give them a somewhat definite general size, and does not produce a large amount of dust fine enough for indefinite suspension. The opposite view was maintained by Prof. H. M. Paul, and was sustained by Mr. Diller, who said that the microscope revealed no limit to the fineness of the Krakatoan dust. The higher the magnifying-power applied, the greater the number of particles visible; and this relation extends to the limits afforded by the capacity of the instrument. Professor Paul thought the violence of the Krakatoan explosion was competent to charge the atmosphere at very great altitudes, and considered the fineness of the dust a sufficient explanation of its indefinite suspension. Mr. William B. Taylor suggested that electricity might be an efficient cause of suspension. It is a common phenomenon of volcanic eruption; and dust particles charged with the same kind of electricity as the earth would be repelled not only by one another, but by the earth. The period elapsing between sunset and the red afterglow testifies to the great altitude of the phenomenon; and at such altitude the air is not only very rare, but is anhydrous, and the discharge of electricity is impossible.

May 10. — Mr. G. H. Williams of Johns Hopkins university addressed the society on the methods of modern petrography, classifying them as chemical, mechanical, optical, and thermal, and explaining their several functions. —— There followed a symposium on the question, 'What is a glacier?' Mr. I. C. Russell defined a glacier as an ice-body originating from the consolidation of snow in regions where the secular accumulation exceeds the loss by melting and evaporation (that is, above the snow-line), and flowing to regions where loss exceeds supply (that is, below the snow-line). Mr. S. F. Emmons defined it as a river of ice, possessed, like an aqueous river, of movement and of plasticity. In virtue of plasticity, it adapts itself to the form of its bed. The *névé* field is the reservoir from which it derives its supply of ice, and the initial impulse of movement. Until the *névé* moves from its wide and shallow bed into a narrower and deeper one, and thus gives outward proof of the plasticity of the ice of which it is composed, it does not become a glacier. It may become crevassed, and it may carry blocks of rock on its surface without losing its *névé* character. Mr. W. J. McGee said that the phenomena of glacier ice and *névé* belong to a graduating series, and can be only arbitrarily discriminated. He regarded as artificial and incompetent classifications depending on acclivity of the ice-bed, on constriction of the ice-body, on ability to sustain bowlders, and on rate of motion. All things considered, the most satisfactory line of demarkation is the snow-line. Mr. William H. Dall discriminated masses of ice moving in a definite direction from fields of ice practically stationary, restricting the term 'glacier' to the former. A glacier is a mass of ice with definite lateral limits, with motion in a definite direction, and originating from the compacting of snow by pressure. Prof. T. C. Chamberlin said that the subject illustrated the fact that hard and fast lines belong only to nomenclature, whereas nature is characterized by gradations. The true distinction in this case is not structural, but genetic. There is an area of growth and an area of waste to every glacier. It is only superficially that the area of growth coincides with the *névé*, and the *névé* field is accurately defined only on the summer day of maximum waste. Capt. C. E. Dutton said that his intended remarks had been anticipated by Professor Chamberlin. Definition can

rarely or never be made rigorous. Glaciers vary in their characteristics like other groups of phenomena. While those features which characterize them are present, there is no difficulty of recognition; but exceptional cases arise in which a portion only of the diagnostic features are present, and persons who desire extreme precision of language are then compelled to hesitate. The difficulty is probably best met by the use of qualifying terms.

NOTES AND NEWS.

Fellows of the American association for the advancement of science, who may desire to avail themselves of the privileges of honorary membership of the British association, and to attend the Montreal meeting, will be furnished with the usual 'travelling certificates' on application to Mr. J. D. Crawford, post-office box 147, Montreal, Canada. These certificates should enable the fellow to purchase conveyance for himself to and from Montreal at reduced rates.

— In regard to the phosphorescence of jelly-fish, R. Meldola writes to *Nature*, that the conclusions arrived at by Mr. Verrill (*Science*, July 4, p. 8) cannot fail to be of interest to all who have ever speculated on the significance of the luminosity displayed by so many Acalephae, Medusae, and other marine organisms. When in the tropics, in 1875, very similar ideas occurred to Mr. Meldola; and in an address on the phenomena of cyclical propagation, delivered to the Essex field-club on Jan. 28, 1882, he ventured to put forward the following views: "It was in the Bay of Bengal, when on the eclipse expedition of 1875, that I first saw shoals of Medusae in their full splendor. Speculating on the meaning of the vivid colors and brilliant phosphorescence of these creatures, I came to the conclusion that both these characters might be protective danger-signals of the same nature, and fulfilling the same function, as the bright colors of distasteful caterpillars according to Wallace's well-known theory, or the phosphorescence of the Lampyridae according to Thomas Belt ('Naturalist in Nicaragua,' p. 320). The 'urticating' powers of the jelly-fish would certainly make them unpleasant, if not absolutely dangerous to predatory fish, and their bright colors and luminosity at night may thus be true warning characters."

— A joint convention was recently held by the council and past presidents of the British institutions of civil engineers, mechanical engineers, and naval architects, and of the Iron and steel institute, and the Society of telegraph engineers and electricians, to take steps toward the erection of a memorial to the late Sir William Siemens. At a meeting held on June 28, it was reported that the authorities of Westminster Abbey would be pleased to permit the introduction of a memorial window in honor of the distinguished physicist and engineer. The cost was estimated at from seven hundred to eight hundred pounds. The proposal was accepted; and it was decided to limit subscriptions to one guinea each, and to receive them only from members of one of these five societies, of all of which the deceased was a member. Subscriptions are payable to Mr. James Forrest, secretary of the Institution of civil engineers.

— Dr. Asa Gray's 'Flora of North America,' part ii. (Caprifoliaceae–Compositae inclusive), is at length issued. It contains 474 pages, mainly devoted to Compositae, which number 1,610 species arranged in 237 genera. For the convenience of distant botanists, it is sent by mail, free of postage, to those who remit the price ($5), and order it of the curator of Harvard university herbarium, Cambridge, Mass.

— In September next a geographical professorship will be established at each of the Russian universities. In Germany, fourteen out of twenty-one universities have a chair of this sort.

— Lessar is again in the Seraks country, and will explore the middle part of the region watered by the Murghâb River, which has never been visited by Europeans.

— The international society for the cure of ophthalmia offers a gold medal for the best essay on diseases of the eye. The medal is designed by Hartzes of Berlin, and bears a portrait of Albrecht von Graefe.

— In Russia the statistics of the last thirty years show a great diminution in the forest-trees, but scantily replaced by the planting of firs, as there is no supervision of forests: there is said to be a consequent change for the worse in the climate, and diminution of fruitfulness, especially in the districts round Nishni Novgorod and Moscow. In the Moscow government, which used to be rich in fruit-bearing trees, apples and cherries have much decreased in number, and pears have wholly disappeared.

— A new fog-horn, invented by Mr. Bryceson, has recently been tried on the Thames by the representatives of the admiralty. It is in the form of a pump, and is worked by a strap fastened to the signalman's foot, and so worked as to produce short or long sounds, as required. The advantages of the invention are, the length of time to which the sound can be drawn out, its cheapness, and the fact that it can be heard for three-quarters of a nautical mile in stormy weather.

— The vertical camera, for use in photographing natural-history objects, is described in a pamphlet, "La photographie appliquée aux sciences biologiques et le physiographie universel," by Dr. A.-L. Donnadieu, and published at Lyon by J.-B. Carpentier.

— In the *Monthly notices* of the Royal astronomical society for May, appears a paper by Professor Hall, upon the motion of Hyperion, the satellite of Saturn just outside of Titan, and whose motion is greatly perturbed by the latter, both on account of its mass, and the nearness and eccentricity of Hyperion's orbit. The mean motion of Hyperion is still somewhat uncertain, from the fact that there are no systematic observations of it since those of Lassel in 1852, until Professor Hall took up the systematic observation of

Saturn's satellites in 1875, upon taking charge of the great Washington refractor. This ignorance of the exact value of the mean motion is especially unfortunate in the case of Hyperion, from the fact that four times this motion very nearly equals three times that of its disturbing giant neighbor, Titan; in which case the perturbations become very large, or, in case this relation is an exact one, the theory of their motions is very greatly modified. Until, then, the lapse of time and continued observation shall show how much the quantity $4n-3n'$ differs from zero, it is Professor Hall's opinion that it will be useless to attempt the complete theory of Hyperion's motion.

To show something of the rapid changes in the elements of the orbit due to the great perturbations going on, Professor Hall has discussed the observations of each year separately, assuming a value of the inclination and longitude of node determined beforehand from his earlier observations, — which quantities are very little disturbed, — and by least squares has deduced for each year, including Lassel's 1852 observations, values of the semi-major axis, eccentricity, and longitude of peri-Saturnium for Hyperion. The most remarkable feature of the results is the rapid retrograde motion of the peri-Saturnium, amounting to about 20° per year for the epoch 1875–77, but apparently diminishing quite rapidly. This motion is comparable with the rapid retrogression of the moon's nodes; but it would seem to be rather irregular, unless the printed annual values of P are liable to considerable uncertainty. Professor Hall calls attention to the desirability and importance of re-reducing Lassel's observations, and publishing them more in detail.

— *Insecten-börse* is the title of an advertising fortnightly sheet just started in Leipzig for the benefit of collectors, dealers, and amateurs in entomology. The first number, composed of four quarto pages, contains a surprising variety and number of objects for sale.

— A blue grotto, similar to that of Capri, has been found on the Island of Busi, off the coast of Dalmatia. It is formed by three connected grottos, which can only be approached from the sea. It is highly vaulted, and is only lighted through an opening under the sea; this causing the glorious reflected blue light.

— It is proposed to hold a special American exhibition in London in May, 1886, at which the products, manufactures, and varied phases of life in the United States, will be represented.

— We learn from *Nature* that Prof. R. S. Ball has accepted an invitation from the Lowell institute, Boston, to give a course of six lectures on 'Chapters in modern astronomy' next October.

— A German expedition has been despatched to Cape Town in the corvette Elizabeth. It is fitted out by the firm of Lüderitz of Bremen, and will afterwards proceed to Angra Pequena. The leader of the expedition is Lieut. Siegmund Israels, a Hamburger, who served in the English army during the Ashantee war. An engineer has been engaged from Düsseldorf, who will use his experience in the service of a Westphalian firm of iron founders.

— We learn from Germany, that the Italian geologists have written to the president of the international geological congress at Berlin, asking that the intended meeting of September next be postponed to another year, on account of the cholera, and the quarantine imposed at the boundary of several kingdoms in Europe. Later information is, that the congress will be postponed to September, 1885, not only on account of the cholera, but also on account of the number of members drawn off to America by the meeting of the British association. It is also stated that the reports of several of the committees could not be ready this year.

— A hypsometric chart of European Russia, prepared by Gen. Tillo, has been published at the expense of the ministry of public works. The altitudes of more than 18,000 points are indicated on this chart, of which 12,000 were trigonometrically fixed, 4,000 determined by levelling, and only 400 rest upon barometric observations. More than 1,500 mean heights for the level of the water at points on various rivers are also included. The chart is accompanied by an explanatory memoir.

— Prof. George H. Darwin of Trinity college, Cambridge, is now in this country, and has lately married a Philadelphia lady, Miss Maud Dupuy. He returns to England after the conclusion of the meeting of the British association for the advancement of science at Montreal.

— *Apropos* of the distinction which has lately fallen to Professor Roscoe of Manchester, — a knighthood conferred by the queen in consideration of his services in connection with the technical education commission, — the London *Academy* calls to mind the fact that he affords a fine example of the union of the qualities needed by the successful investigator with those of a good man of business; and that his popular sympathies have won him the warm regard of the Lancashire workingmen, among whom the study of science is more common than might be supposed.

— According to the *Personal-verzeichniss der Universität Leipzig für das summer semester*, 1884, there are, in all, 3,160 students at the university, of whom 608 are studying medicine, 99 pharmacy, 232 natural science (*naturwissenschaften*), and 137 mathematics. There are 41 Americans at the university, of whom 7 are studying science. Three of the whole number of students were matriculated as early as 1878, and 33 more in 1879. Dr. Caspar René Gregory of Philadelphia has just been appointed privat-docent in the theological faculty in recognition of his researches in textual criticism.

— The following societies will be represented at Philadelphia, in addition to those already mentioned (*Science*, iv. 140): Geological survey of India, Theo. Hughes Hughes (deputy superintendent); Belfast natural-history and philosophical society, Messrs. James Musgrave, Henry Musgrave; Linnean society, Messrs. John Ball, A. W. Bennett, W. Carruthers, C. Delaune, Howard Saunders, and Dr. James Murie.

SCIENCE.

FRIDAY, AUGUST 29, 1884.

COMMENT AND CRITICISM.

we go to press the British association advancement of science is opening its meeting on this side of the Atlantic. ugh the acceptance of the urgent invi- to the British association by the Cana- was tardy, and at first reluctant, the sh have responded at last with hearty will; and the flood which entered Mon- on the early days of this week put the ity of the hotels, and the generosity of eople, of Montreal to the severest test. gh some of the scientific men, best known ne and the American public through their r personal visits, or their writings of a al interest, — men like Tyndall and Hux- Hooker and Lubbock, — have not come to eeting, there are present on the opening sufficient number of the leaders of science ure a notable gathering, and to well re- uch of their American brethren as have long journeys to meet them. Many of vn countrymen are in attendance, glad to iong the first to welcome their colleagues; nany more would doubtless have come, ey not fear they would infringe too much spitalities intended for the honor of trans- ic friends. It is estimated that about hundred have crossed the Atlantic to l the meeting, as members or associates, hat at least six hundred more have been ed from Canada and the United States, ling the fellows of the American associ- who have accepted honorary member-

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e arrangements of the local committee been as thorough and careful as could be ted. The rooms devoted to the use of sociation leave, indeed, something to be d, as many of them are far too small for convenience; but they have generally the advantage, not only of close proximity to each other, but of an airy situation on the upper edge of the city, which may be welcome before the week is out. But, in the halls of McGill college and its affiliated institutions, accommodation was not found for all; and the sections of geography and statistics have been assigned to rooms a quarter of a mile distant, in the city proper. The local committee has thoroughly canvassed the city, and printed a list of places where lodgings may be had. Each member is provided with a handbook of the Dominion of Canada, — a generous volume, accompanied by maps, containing all one could desire, excepting an index, and a plan of Montreal. The latter, however, is printed most conveniently on the back of the large, folding members' tickets. Evening *soirées* and garden-parties, with excursions in abundance, are planned at various times during the meeting; but the sessions are unbroken by any 'lunch,' except such as individuals may obtain at any time for a pittance, in a tent on the university grounds.

The sections meet daily at eleven, and continue in session for five hours without intermission. One sees the association here as he sees it in England, holding its traditions untarnished. In one matter, however, they have given way to Canadian solicitation by permitting the meeting of the association to be opened in American fashion, by addresses of welcome from the city of Montreal, holding a special session for the purpose. One point in which the association meetings differ notably from our own, is in limiting the attendance at all meetings, addresses, and lectures, as well as at all festivities, to members of one class or another. Such a restriction in our own association would doubtless be an additional incentive to membership in places where it holds its meetings, and it could certainly prove no bar

to membership in other quarters. The meeting bids fair to be every thing its promoters could desire.

THE recent earthquake suggests two lines of unsatisfactory reflection. The number of appreciative observations of the shock, discoverable by careful search through many newspapers, is extremely small, although the movement of furniture, the swaying of suspended objects, and the overturning of chimneys, gave ample opportunity for critical examination. Records of time are also inaccurate in the highest degree. Seconds are rarely given, and there is no statement as to the error of the timepiece. In place of this, the temperature of the air, the direction of the wind, and the 'strange appearance of the sky,' are frequently mentioned, as if these irrelevant phenomena were of the highest importance. In a country where earthquakes are, happily, as rare as here, it would not be fair to expect that very many persons should take full advantage of their unlooked-for opportunity of earthquake study; but after making all due allowance for the infrequence of shocks, and for the small share of school instruction bearing on seismology, the general absence of critical observations is disappointing.

More remarkable than the earthquake, more surprising than the lack of observations, is the readiness with which some of those who ought to know better have committed themselves to explanations of the origin or cause of the shock, on the demand of the all-absorbing newspaper reporter. From one professor we learn that the shock "originated somewhere about the Rocky Mountains, and travelled eastward;" another was inclined to refer the disturbance to the "sliding of granite and trap strata, caused by contraction and expansion;" others still, hold to the gratuitous generalization that "every earthquake-shock is an uncompleted effort of nature to create a volcano." Such a variety of opinion fully justifies a reporter's rather sarcastic conclusion: "Thus the three professors differed from each other in their views." This difference is the more to be regretted, as there was excellent ground for agreement in answering the reporters. It would have been very safe to reply, "When we know what has really happened, we may be able to say something more about it."

THE necessity of irrigating extensive tracts of the west has taught us that irrigation has its advantages. The crops raised under it are not only larger, but more reliable, than those of districts where irrigation is not considered necessary. It is somewhat as though the farmer could control the amount and frequency of rainfall and it; shows, that, in countries where the rainfall is abundant, it is distributed in a manner that comes far short of the best. In some parts of the west there is water enough for irrigating purposes, but it flows in large rivers which it would require great expense to turn upon the land. The Upper Missouri and Yellowstone rivers belong to this class. They flow through arid but otherwise fertile districts. They are large and permanent streams, and it seems a calamity that they should be allowed to run forever to waste.

The suggestion of a contributor in another column, that the government take time by the forelock, forestall monopoly, and lead population into this section by establishing gigantic irrigating-works for the utilization of this valuable water, is not so wild as many of the schemes that actually have been put through Congress; as, for example, the Pacific railroad schemes. Is agriculture any less important than commerce? Yet it seems as though, in this chiefly agricultural country, it is the only interest that is unable to obtain a hearing. It has not even a cabinet officer to represent it. To judge from the space assigned to it at the Centennial exhibition, as compared with that devoted to war, for example, one would have supposed that war was the leading occupation of Americans, rather than agriculture. The question of irrigating the arid but irrigable portion of our public domain is destined to

become a leading one in the near future; and our statesmen will do well to begin soon to give it their thoughtful attention.

LETTERS TO THE EDITOR.

Increase in growth of young robins.

THE past season my attention had been attracted to the rapid growth made by a nest of young robins on our porch. Early in July another pair of robins built a nest on a bracket on the same porch, in which the female laid three eggs. I carefully watched the nest, to note the appearance of the young, as I had determined to accurately weigh the young birds daily, after hatching, as I was curious to learn just how much they might increase in growth during each succeeding twenty-four hours, up to the time of flight. On July 28, two eggs hatched, the third being infertile. At two o'clock, July 28, I weighed the young birds separately, as I did for the next twelve days at about the same hour. I have designated the birds as 1 and 2; and the following figures represent their increase in weight in grams:—

No.	JULY.			
	28.	29.	30.	31.
	Grams.	Grams.	Grams.	Grams.
1	5.8	8.7	14.3	21.15
2	6	10	14.7	24

No.	AUGUST.								
	1.	2.	3.	4.	5.	6.	7.	8.	9.
	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.	Grams.
1 . . .	25	33.8	42.5	43.75	51.2	52.45	52.2	53	52.2
2 . . .	26.8	34	43.5	48	52.6	55.3	57.6	57.8	57.8

The above figures are surely interesting, and will, without doubt, surprise many readers who before had no idea of the increase in growth made by the young of birds. As can be seen, the growth made by No. 1 was not so constant and steady as that made by No. 2; and, whereas No. 1 lost some in weight Aug. 8 and 9, No. 2 sustained no loss. The loss in weight was owing, I think, to the great quantity of lice which infested the birds and nest. CHAS. S. PLUMB.

N.Y. experiment-station,
Geneva, N.Y.

The meng-leng.

In China the sphex, or solitary wasp, makes a neat mud-cell in a crevice, puts therein the store of young insects which are to be the food of its own larva, lays its egg in the midst, closes the entrance of the cell, leaving only a minute window in the front wall, and flies away, with reason for such complacency as is produced in the feminine mind by snug housekeeping. The egg develops, the larva sucks the juices of the imprisoned spiders and flies, and finally the little wasp issues through the window, equipped for flight in the sunshine.

The Chinese call this lone, busy, steel-blue insect the 'meng-leng,' and have a peculiar notion of its habits. They say that it has no domestic nor social relationships, but longs, like other creatures, for little folk of its kind. So it makes a cot, and puts therein the child of some fruitful mother of another family, seals the infant carefully into its domicile, and then, flying frequently back from commonplace occupations, it puts its mouth to the little window of the cot, and buzzes and sings 'meng-leng, meng-leng, meng-leng!' And the little creature within, hearing itself constantly called a 'meng-leng,' believes itself to be one, and gradually and surely verifies its name, coming out in due time a perfect sphex.

So in China an adopted child is popularly and poetically called a little 'meng-leng.'

ADELE M. FIELDE.

Indian languages in South America.

Your interesting notice of recent works on 'Indian languages of South America' (*Science*, Aug. 15, p. 138) requires to be completed by the mention of the remarkably valuable treatise by the venerable traveller, J. J. von Tschudi, — 'Organismus der Kechua sprache' (Leipzig, *F. A. Brockhaus*, 1884, 534 p.). For the first time in the history of American linguistics, we have here presented an exhaustive analysis of the lexical and grammatical structure of a native tongue, fully adequate to the demands of modern study. Von Tschudi has made a long investigation of the Kechua. As far back as 1853, he published his treatise upon it, and has twice edited the original text of the celebrated Ollantadrama (1853 and 1875).

The introduction to his last work occupies a hundred and twenty-five pages, and contains a brief exposition of his views on the ancient history and mythology of the Inca race, and on the affinities of their language. Based, as his opinions are, on a most careful analysis of the tongue and on ample personal observation, they must have great weight with future ethnologists and antiquaries. To mention only one of his many novel conclusions, he denies any affinity between the Aymara and Kechua languages, and considers Bertonio's grammar and dictionary of the former (from which such affinity has been argued) as based on a local and corrupt dialect.

I would further add to your list the meritorious treatise of Giovanni Pelleschi, 'Sulla lingua degli Indiani Mattacchi del Gran Ciacco' (Firenze, 1881), where, in the scope of seventy pages, he imparts much fresh information about this little-known tongue; and, if not too remote to be called recent, it is worth while mentioning the republication in Lima, in 1880, of the extremely scarce 'Arte de la lengua Yunga,' by F. de la Carrera, — an idiom presenting many curious features, both in phonetics and structure.

D. G. BRINTON, M.D.

Media, Penn., Aug. 16.

Fish-remains in the North-American Silurian rocks.

Mr. E. W. Claypole states in *Science*, July 11, that he has come into the possession of some fossil fish which lead him to the conclusion that there are forms of fish more ancient in America than are known elsewhere. From Mr. Claypole's letter, I gather that he imagines that the upper Ludlows and the 'bone-bed' are the earliest rocks which yield fish-remains. I would direct attention to the fact that the *lower Ludlow* rocks of England have yielded the remains of fish; viz., the Scaphaspis (Lankester). The Scaphaspis ludensis was discovered at Leintwardine, in *lower Ludlow* strata, which must have been deposited long ages before the accumulation of the upper Ludlow 'bone-bed.' Soon after the shield of this fish was detected, I personally investigated the physical position of the rocks in which it was found. Leintwardine beds are the only locality wh

relics of this first-known fish have hitherto been found. Some excavations, made of late in the passage beds between the old red sandstone and the Ludlow rocks at Ledbury in Herefordshire, have afforded a fine series of the fish found in the 'bone-bed' and passage rocks. Among them, Mr. Piper has obtained plates and cephalic shields of Scaphaspis, Pteraspis, Cyathaspis, and Auchenaspis. Auchenaspis has been found perfect; and much more of the structure of these early fishes has come to light. But there is a good deal of difference in the geological horizon of these fish at Ledbury and that of the Scaphaspis at Leintwardine. The lower Ludlows appear in great thickness at Ledbury, but hitherto they have not presented us with fish.

W. S. SYMONDS.

The Camp, Sunningdale, July 31.

Depth of the glacial submergence on the upper Mississippi.

I desire to call attention to certain facts which appear to me to indicate a submergence of even the highest land at this point, which, it may be said, is near the centre of the driftless area. I am not aware of their having been previously noted.

That which first called my attention to the matter was the discovery that the layer of broken stone which covers the undisturbed rock on the top of the bluffs to a depth of four to six feet, contained numerous shells belonging to several species of pulmoniferous gasteropods. I have thus far obtained specimens of the following species (the identifications were kindly furnished by Mr. Sanderson Smith of the U.S. fish-commission): Helicina acculeata Say, Lymneae columella Say, Helix (Patula) attenuata Say, Helix (Helicodiscus) lineata Say, Helix (Patula) striatella Anthony.

The condition of the shells, and the positions in which found, even more than the mere fact of their occurrrence, indicate submergence by giving strong evidence of wave-action, evidence of which is also seen in the general order and arrangement of the stones composing the layer, especially in the remarkable evenness of its upper surface. Overlying this layer of broken stone, and sharply distinguished from it, is a layer of earth from two to four feet thick, destitute of either stones or shells, and having all the characteristics of the loess, which, in unmistakable deposits, reaches a height of two to three hundred feet above the Mississippi. As the bluffs at this point reach to about five hundred feet above the river, a submergence to at least that extent is indicated, — a conclusion which is sustained by other facts, which I need not now refer to.

G. H. SQUIER.

Trempealeau, Wis.

THE VISIT OF THE BRITISH ASSOCIATION.

ALTHOUGH the British association does not meet officially on our own soil, we may yet regard it as in some sort paying a visit to our neighborhood, and opening up such an opportunity for personal communication between the scientific men of England and America as has never before offered itself. It is true that Principal Grant, as a Canadian by adoption, suggests to the members to be satisfied with Canada on this occasion, "and to leave the United States and Mexico to other and more convenient seasons." He strengthens this suggestion by the statement that the time of meeting of the American association was chosen so as to give the members of that body an opportunity of visiting Montreal, thus correcting the current impression that the object was to make it convenient for the members of the British association to visit Philadelphia. The Canadians may also feel fairly entitled to all the credit which the visit of the association can bring, since so long a journey by so large a body of men would hardly have been seriously considered, but for Canadian enterprise. A proposal was privately discussed among us, a few years ago, to invite the British association to Boston on the occasion of the anticipated exposition of 1883. But, after the exposition was abandoned, no one was so bold as to seriously press the invitation in the absence of any special attraction to second it; and it was left for our neighbors to successfully attack the problem which we had abandoned as hopeless. It is not, however, to be expected that the individual members of the association will be greatly influenced by sentiment in the use they make of their time on this side of the ocean, or that Canadian pride, enterprise, or loyalty, will prevent them from crossing the border. Not even such energy as that of our neighbors, and such glory as that of their dominion, can compensate for the charm of novelty in life and institutions offered the foreigner by such countries as "the United States and Mexico." It may be well worth the while of a studious Englishman to take a long journey to learn from actual inspection what an English province can become under the influence of so energetic a people as those of Canada; but he cannot suppress his curiosity to study the ampler and more varied civilization which his race is working out under political conditions less like those to which he is accustomed. We therefore look upon the present meeting as nearly the equivalent of a visit to our own country, and, in the name of the stu-

dents of science in America, we extend a cordial welcome to the greatest body representative of the intellect of the old world which has ever visited our shores. Did our visitors not represent the most hospitable of nations, we should indulge in bolder assurances of the warmth of the reception they will meet with from all classes of Americans. But those who know what English hospitality is will content themselves with modestly hoping that American hospitality does not fall far short of it, and with remarking that our great railways extend a corporate hospitality to distinguished visitors which is not known abroad.

The sentimental consideration that the visit is one the very possibility of which is a striking illustration of what science has done, will add zest to the occasion. In times past, the idea of a local society choosing a place of meeting across the Atlantic would have appeared as quixotic as can readily be imagined. Indeed, we can but suspect that the project at first presented a little of this appearance to a majority of those concerned, and that a meeting very successful in point of numbers was hardly expected. But the result seems likely to more than realize the hopes of the most sanguine supporters of the project, and it is fitting that the promoters of science should enjoy to the utmost a result which the work of their class has rendered possible.

Circumstances are in several ways favorable for paying us a visit. The time and place of holding the meeting of the American association were especially chosen so as to facilitate the reception of any visitors from the sister-organization who might grace the meeting by their presence. Arriving in Philadelphia, they will find not only our own association, but the electrical exhibition of the Franklin institute. Although the latter cannot be expected to rival the great displays at Paris and Vienna, it will afford a better opportunity than any which has been offered in Europe, for seeing what has been done here in forwarding the utilitarian applications of electricity. Visiting electricians, of whom we may hope for a considerable number, may also expect an invitation to take part in the electrical conference, which is to be conducted under the auspices of the government, and in which the novelties of the exhibition will be made known. Philadelphia is only four hours distant from the national capital, and thus a visit can be made to the collections of the government without any serious loss of time. The division of his time between pleasure and business will be a question for the decision of each individual visitor, to whom the journeys and excursions tendered to the American association will be freely open. He should, however, bear in mind that the colleges and universities are generally in vacation till near the close of September.

Finally, the student of politics and sociology will regard it as fortunate that his visit takes place in the height of a presidential canvass, thus enabling him to study one of the most interesting of political phenomena on the largest scale. If he judges only from the course of newspaper criticism on the presidential parties and candidates, he will doubt what the future has in store for us; but, if he looks deeper, he will see a process of endosmosis, by which, from the huge mass of objurgation, falsehood, and not very elevated humor, political acumen is being infiltrated into the minds of millions of voters. And no one, whatever his politics, need fear the danger of being converted to new principles. Whether he be the most advanced Liberal, or the most conservative Tory, he will have no difficulty in seeing every thing by the light he brings with him, and returning home with all his views strongly confirmed.

LORD RAYLEIGH.

Lord Rayleigh, the president of the British association of science for this year, is well known to all Americans who have kept pace with the development of physical science. Although his reputation cannot be called a popular one, yet no student of physical science can well be ignorant of his investigations; and his treatise on sound places him easily in the front rank of writers on a subject of which the

theoretical and practical importance is second to none in its bearing on the progress of humanity.

John W. Strutt, the third of his race bearing the title Lord Rayleigh, is the eldest son of John James, second Lord Rayleigh, and of Clara Elizabeth Latouche, daughter of the late Capt. Vicars, R.E. He was born Nov. 12, 1842; was educated at Trinity, Cambridge, of which he was a fellow. He was married in 1871 to Evelyn Georgiana Mary, second daughter of the late James Balfour, Esq., of Whittinghame, N.B., and succeeded to the title in 1873.

Lord Rayleigh's career at the University of Cambridge, which he entered at the age of nineteen, was a distinguished one. He secured the Sheepshanks astronomical exhibition in 1864. The following year he came out senior wrangler and first Smith prizeman. Trinity college thereupon elected him to a fellowship, which he held until his marriage, in 1871. In 1879 he was elected to succeed Maxwell as director of the Cavendish physical laboratory at Cambridge; and he received the medal of the Royal society in 1882, and was president of section A of the British association in 1882. This brief record of the important dates in the life of Lord Rayleigh may make his life seem uneventful to the ordinary reader; but the student of his writings will perceive that the years between his acceptance of the fellowship at Cambridge, and his appearance as president of the British association for the advancement of science at Montreal, have been eventful in the scientific sense, and full of work. It was no ordinary compliment to a man to be selected as the successor of Maxwell. We well remember the commendation pronounced by leading English men of science before Lord Rayleigh became director of the Cavendish laboratory, — 'strong man, Lord Rayleigh;' and this simple and peculiarly English method of commendation still expresses the truth to-day. An Englishman said to the writer lately, "They question the necessity of the House of lords and the use of lords. Look at Lord Rayleigh! Cannot we expect from this select body of men of hereditary traits and of inherited possessions great things in science, if they will only abandon the subject of franchise bills and the marriage of wife's sisters, and follow the path pointed out by Lord Rayleigh?"

Lord Brougham, it is true, had scientific tastes, and wrote papers on optics; but, if one wishes to compare the physical science of Brougham's time with that of the present, and, moreover, to compare the scientific attainment of Lord Brougham with Lord Rayleigh, let him read Brougham's papers, and then turn to Lord Rayleigh's investigations on diffraction-gratings, and to his various papers on theoretical optics. Perhaps his most important work is the 'Theory of sound,' in two volumes, begun on the Nile in 1872, and published in 1877–78. This work has received the commendation of Helmholtz, and takes the place, in theoretical acoustics, which Helmholtz's 'Tonempfindungen' fills in physiological and practical acoustics.

In looking at Lord Rayleigh's investigations before the appearance of the 'Theory of sound,' we perceive that he has embodied in this work the special investigations and mathematical work of nearly ten years. Before the appearance of this work, the subject of acoustics had been treated in a disconnected manner. There were geometrical, and what might be called synthetic, treatises; but, with the exception of Donkins's 'Acoustics,' there was no generalized and analytical work on sound. What Newton did for mathematics, when he discovered the method of fluxions, or the principles of the differential and integral calculus, Lord Rayleigh has done for sound. He has bridged over, so to speak, angular intervals, has filled up discontinuities, and has made the general treatment of acoustical equations flexible. In reading this treatise, one speedily finds that it is not a narrow or limited one. The entire range of modern mathematics is employed; and the system of generalized co-ordinates receives, in this treatise, perhaps the greatest exemplification of its power. One cannot read the treatise who has not become familiar with

the highest flights of modern mathematics. Moreover, the lecturer on the great doctrine of the conservation of energy will find that this book is founded upon this doctrine, and opens with its fundamental equations. Lord Rayleigh pointed out, before the appearance of this treatise, the use of a peculiar function, expressing the law of decay, so to speak, and subsidence of impulses in any system or configuration; and although he probably saw its chief employment was in the discussion of the dissipation, and frittering into heat, of sound-vibrations in any complicated system, yet he probably saw, in common with Maxwell, that the dissipation function could be employed in electricity to express the oscillation and change of electrical induction-currents, also, into other forms of energy. The intelligent reader of Rayleigh's 'Theory of sound' has a great intellectual pleasure in tracing in it the methods of reciprocity of similitudes, the illustrations of the conservation of energy, and must rise from its perusal with a clearer notion than he has had before of the unity of physical forces, of the great modern truth of the equivalence between work and heat.

Since Lord Rayleigh has become director of the Cavendish laboratory, he has organized its scientific work, and has made it a centre of physical investigation as well as of instruction. His determinations of the ohm, which were presented to the Paris conference of electricians, 1883–84, were generally regarded as the most accurate, and formed the basis of the unit of electrical resistance now formally adopted. He has lately investigated the methods of obtaining a practical unit of the strength of an electrical current, and has shown that the method by the deposition of silver is capable of a high degree of accuracy. It will be seen that he unites unusual qualities for director of physical science, great mathematical ability, and the power to execute and supervise scientific investigation.

Lord Rayleigh's countenance will soon become familiar to every American man of science; and we hope that even the uneducated American will learn to see in him, not the lord of the manor of Terling and the patron of two livings, but a peer of the distinguished school of mathematicians of Cambridge, Eng., the pre-eminence of which, in mathematical science, American centres of learning can honor, but not dispute.

ATMOSPHERIC ELECTRICITY.

At the present time there is no satisfactory theory of the source of atmospheric electricity. Many believe, in the absence of positive evidence of the production of electricity by the operation of evaporation and condensation, that the earth has a definite charge, which resulted from the operations at its birth, and which it has kept undiminished in amount; and that thunder-storms are merely the expression of local accumulation due to currents of air.

Mr. G. Le Goarant de Tromelin, in a late number of the *Comptes rendus*, advances the opinion that atmospheric electricity is due to the friction of the air, humid or dry, upon the surface of land or water, and calls attention to Armstrong's hydro-electric machine, which produced electricity of high tension by the friction of jets of steam in issuing from narrow orifices. According to Tromelin, the wind, in skimming over the surface of water, carries water from the crests of the waves, which play the part of the comb of Armstrong's machine. The roughness of the soil does the same on land when a damp wind passes over it. The charge thus produced is collected upon the vesicles of clouds. The potential energy of a cloud depends upon its configuration and its temperature. If this configuration changes under the effect of condensation or congelation of the aqueous particles, the cloud absorbs a certain amount of energy, which must be found again under the form of an augmentation of potential energy: hence there is an electrical interchange constantly going on in the cloud region of the air; and when these changes are rapid, and great in amount, we have thunder-storms and other great electrical manifestations.

The advocates of Mr. Tromelin's views can point to the effect of the blasts of sand driven by the wind upon the pyramids, and to the extraordinary electrical manifestations upon high peaks in Colorado, where every *aiguille* seems to hiss, at times, with the escaping electrical charge.

We believe that the time has arrived when the scientific world no longer looks upon electrical phenomena as isolated and separate from the phenomena of heat and light, or chemical reactions. We cannot believe that any change can take place in the arrangement and mutual attractions of molecules without electrical manifestations. If we are to have a thermal chemistry, we must also have an electrical chemistry; and the history of the energy of a chemical reaction is not completely told when we sum up the heat of this reaction, unless we count also the heat-equivalent of the resulting electrical changes. If we were, therefore, to frame a theory of atmospheric electricity, we should begin it with the assertion that every change in the configuration or arrangement of particles of matter is accompanied by an electrical disturbance; and, as far as this assertion goes, all the present theories of atmospheric electricity would fall under it as special cases.

The object of this paper, however, is not to frame hypotheses, but to trace the recent work which has been done in systematic observation of atmospheric electricity. It is only to systematic observation that we can evidently look for information which will be of immediate practical value to our signal-service. Unfortunately, no systematic observations have been made for any length of time in any country.

The electrical conference at Paris, held last April, was adjourned from a meeting of the previous year; and committees were appointed to study the subject of atmospheric electricity and earth-currents in different countries. The time was evidently too short for such a stupendous undertaking; but the conference did valuable work in stimulating systematic observation, and creating a bureau at Berne, to which it was recommended that observations made in different countries should be sent. The agitation of the subject of such observations called forth several papers. Professor Ròiti of Florence presented to the conference the result of observations made through several months with a self-registering apparatus. He found that the zero of Mascart's electrometer changed from time to time, and traced this change to the mechanical effect of the sulphuric acid upon the platinum wire connected with the electrometer needle. He therefore dispensed with the Leyden jar of the Thomson and the Mascart electrometer, and suspended the needle by a very fine silver wire which was connected directly to the positive pole of a water-battery of many cells. This instrument was found to work well. Professor Ròiti believes that local disturbances have great effect, and that these local effects must be carefully taken into account in comparing simultaneous observations over large areas.

Athough the scientific world has generally accepted Thomson's quadrant electrometer, or some modification of it (like that of Mascart's or Clifton's), as the most suitable instrument for the observation of atmospheric electricity,

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Professor Palmieri's methods and instruments do not impress us very favorably. There must be great difficulty in insuring good insulation by his method of suddenly elevating a disk in the air. Moreover, his theory of induction does not appear to us to be well founded. The Thomson method of observing atmospheric electricity seems to promise better results than any other; yet it is not by any means perfect, especially in its practical adaptation to the needs of a government signal-service. The experiments which are being conducted at the physical laboratory of Harvard college show that in the American climate it is extremely difficult to secure a regular flow of water from the water-dropper, and to obtain good insulation, on account of frost and snow. During the months which are free from snow and ice heavy showers wet the insulating stand of the water-dropper, and thus destroy the insulation. The latter evil can be obviated to some degree by a well-constructed screen of wood. It [illegible] been found preferable to neglect the insulation of the can, and allow the drops of water to fall upon a metallic plate, thrust out from the side of the room in which the electrometer is situated, by means of a glass cylinder through the centre of which runs a wire which connects the metallic plate with the electrometer. The drops of water fall, in turn, from the metallic

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IRRIGATION IN THE UPPER MISSOURI AND YELLOWSTONE VALLEYS.

In crossing the great plains over the Union Pacific railroad, through Nebraska and Wyoming, or over the Kansas division through Kansas and Colorado, one is struck not only by the aridity of the country, but also by the fact that no streams of water exist there, adequate, if completely utilized, to irrigate any considerable part of that immense area. One is also struck by the monotony of the physical features, the absence of mountains or hilly areas, as well as of timber. The possibility of settling this vast region seems very remote; and only the discovery of some new and as yet untried method can prevent these plains from constituting, for ages to come, the great natural barrier between the east and the west, — a barrier far more complete than that furnished by the Rocky Mountains themselves.

This condition exists to a greater or less extent as we go southward, though the direction of this belt of uninhabitable country lies somewhat to the west of south. Before I had seen Dakota or Montana, I feared, when reflecting upon these facts, that such a belt might extend northward also, and thus, as it were, actually divide the United States into two sections, marked off from each other by a permanent physical obstruction. This problem seemed to me of the utmost importance, for it is the remote future that must be considered; and if the country has proved capable of so nearly dividing upon an east-and-west line, where there does not exist a single natural feature to render the two sections distinct, what might not be apprehended at some future day, when sectional differences arise between the east and the west, if cut off from each other by an uninhabited desert five hundred miles in width?

It was therefore with special interest that I studied the northern extension of this belt. The fact that the isohyetals actually curve eastward, i.e., that the precipitation is less as we go northward on a given meridian, led me to suppose that the difficulties would not diminish. It is certain, however, that the decreased evaporation, due to the reduced temperatures of the more northern parts of the dry belt, much more than compensate for the difference of rainfall. It is, moreover, currently believed by the inhabitants of these more northern districts, that the atmosphere is constantly kept somewhat moist by the influence of the Pacific coast and the Upper Columbia region. A short sojourn on the Upper Missouri and Yellowstone Rivers convinced me of the accuracy of this view. The general movement of the atmosphere is from west to east. The mountains to the westward are not high, — at least, except at isolated points, — and do not, therefore, suffice to condense all the moisture that passes over them. Near the sources of these streams, as at Bozeman, crops are raised without irrigation, whenever they can withstand the frosts, although the rainfall is there only sixteen inches per annum; and the same is true for eastern Dakota, with no greater precipitation. It is also a matter of record, that the temperature on this latitude diminishes toward the east, and that colder weather prevails in Minnesota than in Dakota, and in Dakota than in Montana. The people attribute this to the occurrence of what they denominate 'Chinook winds;' i.e., winds laden with moisture, and moderated in temperature from the warmer regions of the Pacific slope.

Notwithstanding this, it must still be confessed, that, for all the lower parts of this region of country, — the proper valleys of these rivers, — irrigation is essential to successful agriculture. All statements to the contrary are inspired by interest, usually by the railroad interest, which hopes thereby to increase travel. A number of instances of this came to my notice, one in particular, in which a resident who had published such a statement in a railroad circular was found reaping a field of unfilled oats, six inches high, to be stacked for fodder.

Is this country, then, inhabitable, i.e., capable of sustaining a population? No one will deny that it now possesses advantages for stock-raising; but a country which is only fit for flocks and herds can never have sufficient population to give it importance in a state. A mining region may attract enough inhabitants to become somewhat influential, and will remain so as long as the mines continue to yield. But the only permanent and reliable basis of population is agriculture. It is not necessary, however, that all the land be devoted to agriculture: in fact, it really needs that only a small portion of the soil be actually under the plough to support comfortably a region in which other operations can be carried on in parts not adapted to agriculture. If that portion of the Upper Missouri and Yellowstone valleys which lies between the river and the first general rise or terrace, including the valleys of the numerous *coulées*, or creeks, that flow into it as far as the same level would extend, could be adequately irrigated, this area would furnish an agricultural basis, sufficient, with the great stock-raising region that lies back of it, to

guarantee the ultimate settlement of the country to any required degree of density. I speak of the valleys of these rivers, because it is along these that railroads are either already constructed, or are soon to be constructed; and also, because, whatever may be the case elsewhere, a large part of these valleys far above the flood-line is alluvial in character, and highly fertile.

Now, in comparing this region once more with that of the Upper Platte, whether with the south fork in Colorado, or with the north fork in Wyoming, one great distinguishing fact of the utmost importance presents itself. This fact is, that while, if every drop of the water that flows in the Platte and its tributaries could be turned upon the land, it would only irrigate a small fraction of its own valley, we have in the Missouri and Yellowstone, even in August, a volume of water large enough, if economically applied to this object, to convert the whole of the arable land lying adjacent to them into a rich agricultural region.

Major Powell and his able assistants have carefully calculated the relation of water-supply to irrigable territory; and they come to the conclusion that in Utah a flow of one cubic foot per second will irrigate one hundred acres of land. If this should prove a low estimate for Utah, where evaporation is so rapid that it dries up large rivers almost in their course, it would certainly be ample in the region of Chinook winds.

The volume of water carried by the Upper Missouri and Yellowstone for that part of their course of which we are speaking has not been definitely ascertained. The average annual discharge of the Missouri River at its mouth was determined by Humphreys and Abbott at 120,000 cubic feet per second. A measurement was once taken at the source of the Upper Missouri, i.e., at Three Forks, at a time when the river was found to be four feet below high water, and eight inches above low water, when the volume was found to be 8,541 cubic feet per second. Between these two great extremes we are compelled to estimate for our present purposes. Perhaps 50,000 cubic feet per second would not be an excessive estimate for the volume of the Missouri below the mouth of the Yellowstone; or, assuming, as is claimed, an equal volume for each branch, 25,000 feet each for the two rivers above their junction. The calculation should not be based upon low water, since little use can be made of water in August and September, when the rivers are lowest; while it is in May and June, when the water is still high, that irrigation is chiefly required.

Each of these rivers, could all their water be utilized, would irrigate, at the above estimate, 2,500,000 acres, or nearly 4,000 square miles. This average would hold for points higher up; since the supply of these streams from their tributaries scarcely exceeds the evaporation, and the Missouri is not much larger at Fort Union than at Fort Benton. The distance between these points, by the windings of the river, is 669 miles. If the valley of this river could be irrigated to a width, on an average, of two miles, this would make, at the most, less than 1,400 square miles of surface. This, however, would be reduced in many ways. The smaller curves would be straightened. Much of the way the valley is narrow, and for long stretches, especially in the upper portion, it is reduced to a mere cañon: 1,000 square miles, or 640,000 acres, would be a large estimate for this portion of the Upper Missouri, which certainly would not require more than half of the available water. The same would be true of the Yellowstone; and thus, after thoroughly irrigating their own valleys, these great rivers might, should this be found practicable, furnish large quantities of water, to be conducted from points near their elevated sources to other outlying fertile tracts, which would also become the centres of a wide-spread and thrifty population.

To this scheme, I am aware, many minor objections may be raised, such as the destruction of navigation, about which there would be differences of opinion, but especially respecting the method by which it could be put into practice. This latter question, neglecting all details, we may now briefly consider in its most general aspects.

It is in the nature of things, that the settlers themselves of the districts in question can never carry out this extensive system of irrigation. To be made a practical success, it would require an immense outlay of capital. The few who will go there, knowing that no such system exists, could never afford to inaugurate it. The effect of its not being done must be to prevent its ever being done: therefore, under the ordinary laws of supply and demand, it can never be accomplished; yet no one in this age of great engineering enterprises will deny the physical possibility of such a scheme. Scarcely any one, probably, could be found to question its importance. It must be clear to all, that, if the means of readily irrigating these lands existed, that country would be rapidly filled up by a thriving agricultural population, which would bring after it its customary train of civilizing agencies.

And the political-economist knows that this means increase of national wealth, while the statesman sees in it enhanced national stability and power. Yet, by the natural method on which civilization advances, the conditions to this much-needed settlement can never be secured.

Notwithstanding this, I believe this end will yet be reached. The human race is rapidly outgrowing the natural or genetic method. There is another method, scarcely as yet recognized by the political-economists, but which is being more and more resorted to by enlightened men for overcoming such great physical obstacles to the attainment of clearly-perceived advantages. This is the method of foresight, or calculation. Individuals employ it for the attainment of both private and public ends. Capitalists combine, and lead civilization into regions it would otherwise never have penetrated. It is very probable that a gigantic irrigating company will some time be formed, which will, by degrees, accomplish more or less satisfactorily the desired object. But, in such case, great evils are likely to result, — evils analogous to those that have arisen from permitting great corporations to construct much-needed transcontinental lines of railway. An immense irrigation monopoly would inevitably grow up, which would largely neutralize the benefits derived from the project. Settlement would be impeded by excessive water-rates; and endless litigation, and conflicting legal decisions, would constantly deter population, and jeopardize industry.

A far better plan would undoubtedly be state action. If the territory of Montana possessed the means to undertake such a scheme, it could scarcely fail to prove highly remunerative at the end of a certain period. But here some such an obstacle exists as in the case of mere spontaneous settlement. Not until these tracts are already well-peopled will the territory possess the means of inducing settlement; and we have again a 'vicious circle,' which ends where it begins.

The only unobjectionable plan, as it seems to me, is *national* action. The nation is the largest of all capitalists, and, at the same time, has no tendencies towards monopoly. If we could obtain the same degree of collective foresight in the general government as exists in the average capitalist, nothing could be easier than for the United States, acting as a corporation that seeks only its own interest, not only to secure the particular end of which we are now speaking, but to develop its own resources, and increase its wealth and prosperity in numberless other directions, by the ordinary exercise of such foresight.

The present case seems to be one in which the nation has a special interest, rendering it peculiarly fitting that it should extend its aid. It is of the utmost importance as a matter of *national* security, and of immunity from dangers which no statesman can foresee, that the rapidly-growing west, with its peculiar interests, be cemented as speedily and firmly as possible to the east; and nothing can so effectually secure this end as to make the population of the entire Union an unbroken phalanx from the Atlantic to the Pacific.

LESTER F. WARD.

LAWSUITS AGAINST GRUBS AND GRASSHOPPERS.

EVERYBODY knows that migrations of grasshoppers were a hard plague in biblical times, and even before them. Ever since those remote centuries this plague has not ceased to disturb mankind, accompanied or followed by failure of crops, by famine and pestilence. Wherever these hideous guests arrived, the most persistent war has been waged against them, but it has always ended with the defeat of mankind. The consequences were the same as in all other defeats in those remote times. When men were helpless, the intervention of the law or the intervention of God was called upon to interfere, and to stop the ravaging intruders. The reasoning of the people was indeed rational, considering the low state of culture and education. The officers and representatives of the law, as well as the clergy, the natural interpreters between the people and God, were obliged to submit to the wishes of the helpless and therefore unruly people. It is to be supposed that both acted in good faith; nevertheless, we find sometimes indications of a more advanced intelligence, and it is evident that they have then submitted only because resistance was impossible. As such proceedings would have been too ridiculous and useless if not done in a seemingly lawful and imposing form, we find that by and by the development of laws against obnoxious creatures in the middle ages was perfected. A defender was given to the miscreant, as it was deemed lawful that he could not be judged and condemned without being heard and defended. According to the opinion of the old jurists, even to the devil a defender cannot be denied: therefore we find a number of curious law cases reported in those times. In the south of France, a pig which had killed a child was condemned and hanged. Some thieves were hanged, together with their dogs; and the Lex Carolina contains a number of paragraphs, not very fit to be repeated, which imposed the sentence of death on animals. Lawsuits against creatures obnoxious to men, and injuring their property, are often reported by the chroniclers, sometimes with a certain kind of

humor. Grasshoppers and grubs were the most frequent offenders.

Bartholomaeus Chassanaeus, a jurist of repute in the old territory of Burgundy, proposed a course of proceedings proper for such a lawsuit, and its consequences, — the judgment of excommunication. He says, after written summonses are served, and after a judge is appointed, two advocates are to be chosen, — one for the people, the other for the grasshoppers. The first begins the case against the defendant, and concludes finally that the grasshoppers should be burnt. The other advocate objects, and answers that the order cannot be issued until after a judgment has been rendered that the grasshoppers should leave the country. If this was not done by the defendant in a specified term of days, the thunder of excommunication was to be thrown on the defendant.

A later jurist, Job Ludolf of Saxony, a man with the extraordinary knowledge of twenty-five languages, speaks in 1694 at some length against the proceedings just related. He declares himself to be pained by the lack of knowledge of the law of excommunication shown by Bartholomaeus, and by the miserable arrangement of the process as proposed by him. Apparently it was at that time not the fashion of to-day among lawyers to begin with the slur of "a slight difference of opinion, as emitted by my honored friend on the other side." Ludolf says, when the greater excommunication is intended, the defendant has to be summoned before the court in the prescribed manner the first, the second, the third, and the fourth time, and then has to be brought before the court. Then comes the answer of the defendant. The argument and the principle of law must be given, so that it may appear whether the controversy consists in a difference about facts or law. It must be decided whether witnesses are needed, and on whom the burden of proof falls. Other parties interested in the case ought to be thought of: for instance, tame and wild birds should be heard, because they are in danger of being deprived instantaneously of their favorite food; the Acridophagi (grasshopper-eating people) should be heard, as they could otherwise take exceptions, and move the nullity of the case, or they could by appeal from the judgment, which injures other parties and is therefore unjust, suspend the execution of said judgment. Further, it would be unjust to compel grasshoppers to leave and to go to neighboring territories; and perhaps it would be more to the point to allow them to be eaten by any one who likes them. The proceeding proposed by Bartholomaeus, says Ludolf, could never be proved to agree with the decree of the Holy See; and nothing like it is to be found in the Pontificale Romanum. There is a threefold excommunication, — the minor, the major, and the anathema (which is the end of all), — "that the culprit's body is given over to Satan, to save the spirit for the day of the last judgment." After all, it seems that lawsuits in those days have been very similar to those of to-day, — not shorter, not less complicated, except that nothing is mentioned about retainers and obligatory fees.

It is only right to state that Ludolf concludes with the following words: 'But of what use is all this against disgusting beasts?' It is praiseworthy, that, among the twenty-five languages known by him, he chose just the one known by everybody to express feelings which could easily have been followed by more than dangerous consequences in those dark times.

In 1479 appeared in the canton of Berne, Switzerland, an enormous number of grubs; and it was feared that the whole crop would be destroyed: therefore the council of the commonwealth sent a deputation to the Archbishop of Lausanne, with the petition to banish the obnoxious creatures from the canton. Of course, it is not stated that the neighboring cantons had agreed to receive the grubs, but the archbishop seems not to have considered the incongruity of said petition. He gave an affirmative answer, and authorized the priest at Berne to impose the banishment of the grubs, providing for strict observance of the customs and laws. After a prayer, an advocate for the people was chosen. He notified the court of his appointment, and proposed the citation of the grubs. On a certain day some of the grubs were brought before the court, and their advocate chosen. The priest, followed by a large crowd of pious people in a solemn procession, went to the cemetery, to the fields, to the vineyards, and to the banks of the river, to serve the summons on the defendant. He delivered the following, at that time probably courteous, address as warning and as citation to the felons: —

"Ye hideous and degraded creatures, ye grubs! There was nothing like ye in the ark of Noah. By orders of my august superior, the archbishop of Lausanne, and in obedience to the holy church, I command ye all and every one to disappear, during the next six days, from every place where food grows for man or beast. If not obedient, I enjoin ye to appear on the sixth day, at one o'clock, afternoon, at Willisburg, before the Archbishop of Lausanne."

As some righteous people objected because the citation was not exactly made in the manner provided by law, the case was postponed, and, after a lawful citation, another day was named. Then the process began. The advocate chosen for the defendant was Jean Perrodet, a well-known dogmatical and obstinate disputant. Perhaps it will appear somewhat doubtful if the nomination of this advocate fulfilled exactly the demands of the law and custom of the time, as it is stated that Mr. Perrodet died a short time before his nomination. Nevertheless, the case and the complaint were read; and, as no defender appeared, the judgment was given for the plaintiff.

"We, Benedictus of Monferrand, Archbishop of Lausanne, condemn and excommunicate Ye obnoxious worms and grubs, that nothing shall be left of Ye, except such parts as can be useful to man."

The government ordered its officers to report the consequences of the excommunication; but the saucy chronicler says "that no success had been obtained — probably on account of the sins of the people." In the year 1338 immense swarms of grasshoppers came from Tartary to Hungary and Austria, and arrived the day of St. Bartholomew at Bozen, South

FIG. 1.—BOTTOM OF THE SEA AT A DEPTH OF TWELVE HUNDRED METRES, PEOPLED WITH COELENTERATES (MOPSEA), IN THE BRANCHES OF WHICH CRABS (GALATHEA) CRAWL ABOUT, AND BY SILICEOUS SPONGES ATTACHED TO CORALS (APHROCALLISTES), OR ANCHORED IN A VASE (CHONDROCLADIA).

Tyrol. The migration lasted seventeen days, from morning till night. The grasshoppers came down and ate every thing, grape-vines excepted. The swarms were so thick that the sun could not be seen, and they went farther to the shores of the Mediterranean. But the eggs and the young ones hatched from them were left behind: therefore a process was begun against them. The grasshoppers were condemned and excommunicated by the priest of Kaltern. The judgment was framed as follows: —

"As grasshoppers are obnoxious to the country and to men, be it resolved by the court that the priest shall, by candles burning from the pulpit, condemn them in the name of God, of his Son, and of the Holy Ghost."

A similar process was begun in the year 1516 against caterpillars in Troyes, France.

H. A. HAGEN.

THE LOWER FORMS OF LIFE DREDGED BY THE TALISMAN.[1]

ACTINIAS, generally known as sea-anemones, attract attention both by the beauty of their forms and by their bright and varied colors. They are represented in the deepest waters, and some forms gathered on bottoms at from four thousand to five thousand metres possess a color as beautiful as that of the shore species.

Madrepores have a carbonate-of-lime skeleton. They are present sometimes in abundance to a depth of twenty-five hundred metres. Madrepore branchus generally covers large districts, and often the cords of trawls dragging on bottoms inhabited by Lophelia were torn in shreds. Solitary madrepores are very numerous, and especially affect muddy bottoms; and they have beautifully varied forms, some resembling a cup, others a horn, and still others having the form of flowers.

FIG. 2.—GLOBIGERINA AND ORBULINA, MUCH ENLARGED. (From *Science et nature*.)

Various forms of alcyonarians, a special group of corals, were found at considerable depths. At the Cape Verde Islands the same species of coral which is found in the Mediterranean, and is of so great commercial value, was found at a depth of a hundred metres. Between five hundred and six hundred metres there was found an interesting alcyonarian, Coralliopsis Perieri, which much resembled Dana's Corallium secundum of the Fiji Islands. Isis and Mopseas (see fig. 1), with slender rods formed of a series of calcareous cylinders supporting flower-like polyps with eight bi-pinnated tentacles, were taken at twenty-five hundred metres. Other forms, with gorgons, having a horny axis with metallic reflections like gold, people with their graceful forms the abysses of the ocean.

The sponges form one of the most interesting parts of the Talisman collection. One generally thinks of these as always possessing the characteristics of our commercial sponges. When one sees their wonderful tissues, formed of needles interwoven with glistering white rock-crystal, one is impressed, first with surprise, and then with admiration. Sponges are distributed from the coast to the greatest depths explored (five thousand and five metres). The littoral or shallow-water forms have a horny or calcareous skeleton, while those living at great depths have a skeleton formed of siliceous spicules, sometimes free, sometimes joined into a network. The most remarkable siliceous sponges are Holtenia, shaped like a bird's nest, having at the circumference, or else only at the base, a long *chevelure* of siliceous threads, enabling it to anchor to the bottom; Euplectellas, having the form of a long trellised horn; and Hyalonema and Chondrochladia (see fig. 1), which thrust into the mire a strong twisted fringe of long spicules, resembling spun glass. Among the siliceous sponges, in which the spicules form a kind of network, Aphrocallistes is most remarkable, a specimen of which is represented in the plate. In this sponge the needles form hexagonal meshes. Prolongations like glove-fingers, more or less distorted, detach themselves from the central part; and some of them, on coming in contact with solid bodies, or rocks, or corals, attach themselves very closely. The upper portion of the sponge (see fig. 1) is closed by an elegantly formed siliceous basket-work. As the colony increases, several of these trellises are formed.

The last animals to be mentioned, the Protozoa,

[1] Abridged from the French of H. FILHOL in *La Nature*. For previous notices see *Science*, Nos. 62, 68, 71, and 78.

are the most degraded in organization, and inhabit the bottoms of all depths. Foraminifera are so plenty at some points, that Mr. Schlumberger has counted

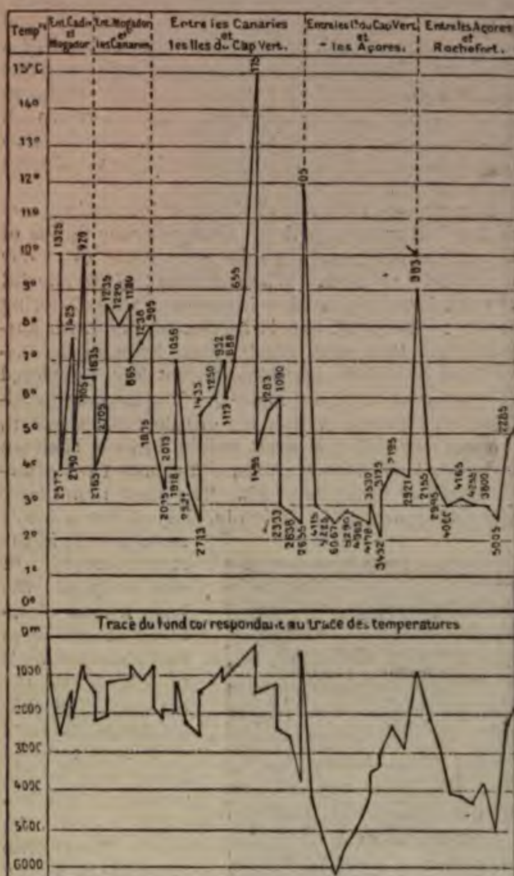

Fig. 3.—Thermometric curves, and corresponding depths of the ocean-bed.

more than a hundred thousand of them in a cubic centimetre of mire. They live at the bottom of the ocean, and not, as formerly supposed, at the surface; and the accumulations from their tests (see fig. 2)

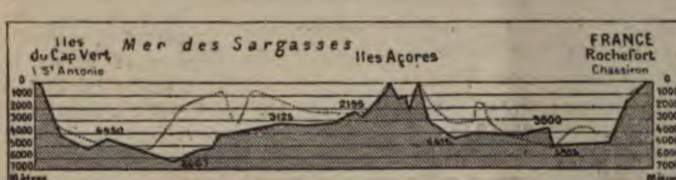

Fig. 4.—Profile of the ocean-bottom traversed by the Talisman.

make what is termed the 'Globigerina ooze,' and will form, in the course of time, beds like those of certain geological horizons of the tertiary of Europe.

In 1868, during a cruise of the Porcupine, Mr. Carpenter and Sir Wyville Thomson discovered, among the particles of lime brought up by the dredge, a sort of jelly which made very slow movements. Within it were calcareous corpuscles of peculiar shape, which some naturalists thought to be the products of the protoplasm itself, while others thought it the *débris* of calcareous algae. Huxley called it Bathybius Haeckeli. This discovery caused a great sensation; and it was questioned whether this living slime did not at certain periods undergo evolution, and then give rise to new creatures. Wyville Thomson could not find Bathybius, and it was discovered that previous observers had been deceived by a chemical reaction. The supposed Monera was nothing more than a simple gelatinous precipitate of sulphate of lime, as it forms when concentrated alcohol is turned into sea-water. The mode of preservation of the lime had created Bathybius.

Here the general description of the results of the cruise of the Talisman is brought to a close. Yet I have thought it would be interesting to show the result of our researches on temperatures at great depths; and I have drawn two curves (fig. 3), the upper showing the thermometric records, the lower the corresponding depths. On examination it will be noticed that they do not always agree. Thus the lowest temperature we found was at 3,432 metres, while it was a little higher at 5,000 and 6,000 metres. From this the importance of deep currents, and the part they play in the distribution of life in the ocean, may be judged.

Another curve (fig. 4), drawn by Mr. Milne-Edwards, shows the profile of the bottom of the sea between the Cape Verde Islands and the Azores, on the one hand, and between these islands and France, on the other. Our relief differs considerably from that indicated on the German charts recently published (see dotted line).

KOREAN CURIOS.

Possibly the most curious things in the possession of the Korean embassy, which recently visited the United States, were two thumb-rings (fig. 1), worn by the Prince Min Yong Ik one at a time, and usually on the thumb of the right hand, apparently rather more as an object to play with than as an ornament.

One of them, supposed by the prince to be jade, was found, on examination, to be serpentine; hardness 4.5, and specific gravity 2.62. It was white in color, with an oily lustre, and had on it a number of small brown stainings resembling an oxidation of iron. In the centre of each spot, apparently forming a nucleus, was a small, dendritic, moss-like marking. This ring measured 34 millimetres across the opening, the width of the opening being 22 millimetres. Its length was 28.5 millimetres. One

edge was ground off quite sharp, and the other rounded. One of the rings was noticed to be slightly flattened on one side.

FIG. 1.

The spectacles worn by the embassy (fig. 2) were rather curious as regards form and size. They were made of transparent, colorless, and smoky quartz, and are worn more to rest the eyes than as aids to sight.

FIG. 2.

One pair, with glasses of smoky quartz, was very curiously marked, or rather streaked, showing the twinning of the crystal; and this feature was commented upon by them as a desirable one. The material of the glasses is obtained from Kyeung Ju, in the south-western part of the province, and is manufactured by thirteen spectacle-makers of note; there being also, in addition to these, a number of inferior workmen. The frames are made of horn, measuring five inches and a half in length, and two inches in width across the glasses.

The amber beads which they wear (fig. 3) are all imported from Europe, and a peculiar, long, rounded one was used as a button.

FIG. 3.

A curious button (fig. 4) is also used by them. It is worn on each side of the head, behind the ears, sewed to a velvet band; and a string attached to the hat passes under the button to hold the hat on the head. When made of gold, they denote the highest rank, and are worn only by the prince.

Every Korean woman wears two rings, always exactly similar in every respect, and as a rule perfectly plain. These are half oval in form, and are made either of gold, silver, amber, or coral. The coral, until recently, has been brought from China, and must have been cut from very large branches of this material.

FIG. 4.

They themselves say that their ladies are the best, or rather the most elaborately, dressed women in the world. In confirmation of this, the prince gave as his reason for leaving his wife at home, that her clothes would not have stood the wear of the journey.

The prince described some crystals which must be the most remarkable yet known for quartz, if there is no error in his statements. They were described as hexagonal in form, and in length six times the height of a man, while over one foot across. After being shown a sketch of stalactites, the prince made a drawing of the crystals which showed the distinct terminal planes of quartz; and he insisted that they were not the same as the stalactites. They were described as red and white in color. It is barely possible from their form, that they are crystals of trap; but from their color and terminations it would seem otherwise. They are found rising from the water at Ohoong Sokh Chung, Kong Won Do, Tsing Chun county, a province on the east coast of Korea.

GEORGE F. KUNZ.

THE HISTORY OF AMERICAN INSTITUTIONS.

Johns Hopkins university studies in historical and political science. HERBERT B. ADAMS, editor. Vol. i. Local institutions. Baltimore, *University*, 1883. [470] p. 8°.

THE first volume of the Johns Hopkins university 'Studies in historical and political science' for the year 1883 is devoted to the subject of American institutions of local self-government, — a subject which has heretofore been greatly neglected, or, at any rate, treated in only a fragmentary and irregular manner. The present is the first attempt made to investigate it comprehensively and systematically; not exhaustively, by any means, or with any pretence to completeness, even of outline. Certainly, no person would look, in a year of independent studies, for any thing more than a commencement of so large a work. As the second year's issue does not propose to continue the same line of investigation, it seems fitting to examine the results of last year's labors, and determine what they have accomplished, and what they leave to be accomplished.

The studies before us embrace a wide range and variety of subject, including no fewer states than Massachusetts, Connecticut, Pennsylvania, Maryland, South Carolina, Michigan, and Illinois, — states far enough apart, one would think, in origin and character, to include every phase of American municipal life. Notwithstanding the admirable judgment, however, with which the subjects have been selected, it will be seen at a glance that there are vital omissions. New York, which has afforded the model for municipal government for almost the entire north-west, and which has some traces of the Dutch system still left; Virginia, the ruling state of the south, and

representing the cavalier instincts of English royalists; the survivals of French institutions in Louisiana, and of Spanish farther west and in Florida,—these, at least, must come into a complete scheme; and those of New York will probably be found the most important of all, so far as the genesis of American local institutions is concerned.

The principal line of investigation in this group of studies has been conducted by Prof. H. B. Adams, the editor of the series, and has been devoted to showing the organic connection between the town institutions of New England and the corresponding institutions of Old England. No less than five papers are devoted to this end,—No. 2, 'The Germanic origin of New-England towns;' No. 4, 'Saxon tithing-men in America;' No. 8, 'Norman constables in America;' and Nos. 9 and 10, 'Village communities of Cape Anne and Salem.' These five papers contain a very interesting account of the corporate features, and the most primitive magistracies of the New-England towns.

The corporate quality, the continuity of existence, the identity of organization and of magistrates,—all these points are well brought out in these papers; but the most important feature of the New-England town-system remains yet to be explained,—the town-meeting, which John Adams placed with good right as one of the four corner-stones of New-England democracy.

The New-England town-meeting is a wholly unique institution. There have been popular assemblies often in history; but the New-England town-meeting differs from all these by radical and fundamental features. Not that it possesses any attribute of real sovereignty, or even any independent original action: it is an institution of wholly subordinate character, and with derived powers, as is shown by the fact that its sphere of action is absolutely limited by the specifications of the warrant. No business can legally come before the meeting which is not definitely stated in this instrument.

A more important characteristic—that, indeed, in which it differs essentially from every other popular assembly—is what we may call the *parliamentary* character of its procedure. Just as the British parliament, representing the people of Great Britain, sits in judgment upon the king and ministers, who hold their places by its will, and subjects them to a rigid accountability, just so the people of the New-England towns, assembled in March meeting, supersede for the time the town magistrates. For that day the selectmen are private citizens. The first business of the meeting is 'to choose a moderator;' and the moderator is the officer of the meeting, wholly independent of the selectmen, just as the speaker is the officer of parliament, wholly independent of king and council. The town-meeting, like parliament, holds the strings of the purse, and not merely votes taxes, but appropriates them to definite objects of expenditure.

This is a feature peculiar to the New-England popular assembly: it is not English, it is not even Teutonic. The English court-leet and folk-mote, the Frank *mal*, as well as the Athenian *ecclesia* and the Roman *comitia*, were presided over by the magistrate who summoned them; and the same is true of the town-meetings in most other parts of the United States. It is from the effective responsibility thus exercised over the town-officers by the body of the citizens, that the peculiar vitality and democratic character of the New-England town-system, noticed by De Tocqueville and others, are derived. The origin of this remarkable feature seems the most interesting and important question in the history of New-England local institutions.

The western states have, as a rule, modelled their town-system upon that of New York rather than of New England,—a system better in many respects, but differing from it chiefly in the absence of the town-meeting. It follows, as was remarked before, that the New-York local institutions are historically the most important of all, and that the most important problem to be solved in these investigations is the cause of this divergence in institutions between two English communities in the same latitude, and separated only by an imaginary boundary-line. Maine and New Hampshire, proprietary colonies, fell spontaneously into the system that prevailed in the charter colonies south of them; perhaps, in part, for the reason that they were, one temporarily, and the other for a much longer period, annexed to Massachusetts. How did it come about that this group adopted this unique system of self-government, while New York, their nearest neighbor, developed so different a system?

This question finds a partial answer in Mr. Gould's paper (No. 3) upon local government in Pennsylvania, in which the policy of the Duke of York is briefly described. This "was a close imitation of the English system: it recognized the old municipal divisions of ridings, towns, and parishes." It is just at this point that we need further elucidation. Mr. Gould's theme confining him to the special

forms of local government developed under the proprietary government of Pennsylvania. 'Towns and parishes,' — these are in English institutions, as a rule, identical; the parish being the ecclesiastical organization of the township, as the manor is its feudal form. Now, it is a significant fact, that south of Mason and Dixon's line the manor was the form adopted, in which the popular assembly was the court-leet. One of the most interesting and valuable papers of the whole series is that of Mr. Johnson (No. 7), upon old Maryland manors, with the records of a court-leet and a court-baron; which records "are the first of their kind that have been utilized by students of Maryland history." But the parish, primarily ecclesiastical, though also used for civil purposes, existed by the side of the manor, as shown by Mr. Ingle, in his paper (No. 6) on parish institutions of Maryland, and by Mr. Ramage, in his paper (No. 12) on local government in South Carolina. The parish, in the beginning regularly conterminous with the town, was also found in New England, where the Congregational Church was established by law, as the Episcopal was in Maryland and South Carolina.

Now, it is an important fact, in connection with this inquiry, that it was just in the period before the planting of the English colonies in America, probably as a result of the Reformation, that the parish became the regular organ of local self-government in England. Its vestry was an assembly of all inhabitants of the parish, not for church concerns alone, but for all matters of public interest, thus taking the place of the old court-leet, or popular court of the township. It is probably from this vestry that the New-England town-meeting was derived, with considerable modifications and enlargement of powers. It was, it must be noticed, fully as ecclesiastical in character as the vestry, none but church-members being allowed to take part in it; and, a significant fact, the name of its elected president, 'moderator,' appears to have been taken from the usage of the Scotch church assemblies. The English vestry was regularly presided over by the rector.

It appears probable, therefore, that, while the New-England 'town' was a direct descendant of the English town, its assembly, or town-meeting, was not derived directly from the court-leet, or primitive popular assembly, which had become feudalized, and brought under the authority of the lord of the manor, but from the vestry, — the form of public assembly which alone possessed vitality and a certain democratic character at the close of the sixteenth century. It may be inferred from Mr. Gould's statement, that the New-York town-system had the same origin; but for some reason its assembly never received the remarkable development of that of New England, and the town itself was reduced to comparative insignificance by the establishment of a county-system of a character intermediate between that of the south, where the county is the principal civil division, and that of New England, where it is hardly more than a group of towns.[1] The system thus created, the relation between county and town established in New-York, with the distinctive town-system which exists in connection with it, may fairly be called the American system. It has spread in the west to the exclusion of the New-England system; and, as is shown in Mr. Shaw's interesting paper (No. 3), on local government in Illinois, it is driving out the southern system, even where the latter had the start. It should be noticed, at the same time, that the Illinois town-meeting, differing from that of most of the states of the north-west, is shown by Mr. Shaw to have been modelled upon that of New England.

The admirable work done in the first series of these papers needs, therefore, to be supplemented in two directions in particular. First, the Virginia county-system, that which appears to have controlled local institutions generally in the south-west, should be described. Second, it needs to be shown how the New-York county and town system, which at present exercises a controlling influence throughout the north-west, and is successfully rivalling the Virginia system, even on its own ground, came into existence.

There remain several interesting subjects, discussed in these papers, into which we have not space to enter. It will be only necessary to mention Mr. Johnston's 'Genesis of a New-England state' (No. 11), in which the town principle is shown to have had a peculiar and remarkable career in Connecticut; Mr. Bemis, upon local government in Michigan and the north-west (No. 5); and Professor Adams's illustrations (already mentioned) of land communities in Massachusetts. This subject, it may be stated, has been examined with the aid of original documents, and with considerable fulness of detail, by Mr. Melville Egleston, in

[1] [In Rhode Island the towns have some of the functions which counties have in Massachusetts, and the power of the county becomes far less important. For instance: in Massachusetts the county lays out highways; in Rhode Island this is the function of the town, and it sometimes happens that roads on opposite sides of a town-line do not connect. — Ed.]

a pamphlet entitled 'The land-system of the New-England colonies,' — a work which well supplements the series before us.

THE EXPLORING VOYAGE OF THE CHALLENGER.

(*Third notice.*)[1]

ONE of the most important of all the outcomes of the expedition is undoubtedly Alexander Agassiz's memoir upon the Echinoidea (vol. iii., 321 p., 45 pl.) which occupies fully two-thirds of one of the massive volumes of the report. Mr. Agassiz's personal acquaintance with all known types of Echinoidea, recent and fossil, gives him an advantage as an authority over all his contemporaries; and, without some such special training, it would have been a matter at least of extreme difficulty to decipher the complex relations of the multitude of singular forms intermediate between the faunas of ancient and modern times, which have been brought to light by the Challenger expedition. The value of these collections may best be shown by a bit of statistics. When the author's 'Revision of the Echini' was publishing (1872–74), there were enumerated 207 species, distributed in 89 genera, including 2 deep-sea species discovered by the Porcupine, and 13 by Count Pourtalès. In the general list which accompanies this report, there are 297 species and 107 genera enumerated, making, in all, 90 species and 25 genera added to the former list, in spite of the reduction in number by the cancelling of nominal species. This shows that 80 species of deep-sea echinoids have been discovered since those of Mr. Pourtalès, and that fully one-third of the whole number of known species of Echinoidea have been discovered since the days of deep-sea dredgings. It would seem absurd to attempt, in a review so limited as this, even to call attention to the main points of interest in a memoir of such extent as this. The most instructive chapters for biologists in general, however, are those upon the "character of systematic affinity of allied groups of Echinoidea" (p. 18), upon the "relations of the Jurassic Echinoidea to the echinid faunas of the present day" (p. 19), upon the "connection between the cretaceous and recent echinid faunas" (p. 25), and upon the "geographical range of the continental and abyssal species" (p. 246); in which latter, especially, is pursued a line of thought of great importance to all those who are considering the problems of the origin of marine faunas. Roetter's lithographic delineations are especially worthy of admiration.

Another paper, especially satisfactory by reason of its extent and completeness, is Col. Theodore Lyman's report on the Ophiuroidea (vol. v., 387 p., 48 pl.). This is a monograph of all the known species (500 in number), and is illustrated by about 750 beautiful lithographic figures, drawn by L. Trouvelot. Mr. Lyman's introductory remarks, with his diatribes against genealogical tables and theories of phylogeny, will delight even those whom he intends to criticise, so genial and keen is the humor with which his views are expressed; and there is something refreshing, too, in the curt, sharp-cut phrases in which his general conclusions are formulated. Exceedingly interesting, too, is the manner in which the writer has succeeded in framing his diagnoses of species, genera, and families, in simple words, half of them of one syllable, and Anglo-Saxon in origin at that. He surely has fulfilled his intention "not to add to the jargon in which zoölogy is now smothering," — a jargon, he declares, "such as Molière would scarcely have ventured to put in the mouth of the medical faculty in his Malade imaginaire." The number of new species added by the Challenger was 170, with 21 new genera. The tables of distribution, geographical, bathymetrical, and thermal, with the 'brief reflections on their indications,' are suggestive in many directions, and we regret that the reflections may not here be quoted at length. In general terms, it may be said "that a very large proportion of the species live exclusively on the littoral zone, and that therein are included species both of cold and of hot water, though the number of the latter is much the larger. Then there is a large fauna of 50 species, which live exclusively below 1,000 fathoms, and which have to endure a degree of cold near to freezing, an enormous water-pressure, and an entire absence of sunlight. Between these extremes there are large groups whose favorite, or even necessary, habitat is restricted to given depths." Sixteen genera do not go lower than 30 fathoms; and they, without exception, inhabit warm seas. "This proves that certain groups demand a high temperature, and cannot accommodate themselves to a lower one. Should any of them, therefore, be found fossil, it would be reasonable to infer that the horizon was a shallow covered by warm water. Nine genera have not yet been found above 1,000 fathoms:" their occurrence, therefore, as fossils, might denote a geological bottom of great

[1] [F]or previous notices see Nos. 66, 79.

depth, and covered by cold water of very heavy pressure.

The reflections of the author upon the thermal tables are to the effect that the warm-water species, which are also of comparatively shallow water, are by far the most numerous,—a proportion which suggests that heat, light, and small pressure tend to produce variety in form and structure. "Yet," it is remarked, "there is not that vast difference between deep cold species and shallow warm ones which might reasonably be looked for, on the theory that so-called natural forces are alone potent to effect change."

The work on fossil species is simply a review of the present state of knowledge, which is admitted to be very unsatisfactory. At present it cannot be said that a single fossil genus is identical with the living; but there is much unstudied material in museums. The index is a workmanlike conclusion to a most scholarly production; and our transatlantic fellow-workers, who insist in their reviews upon calling the author Professor Lyman, will be surprised to know that he is not a professional zoölogist, but that science has been simply his diversion, in the midst of many other time-consuming occupations, as legislator, fish-culturist, farmer, and politician.

Two papers more will complete work upon the echinoderms, and these are being prepared by Mr. P. H. Carpenter of Eton college. The Comatulidae were his from the start; and the stalked crinoids, which were reserved for his personal study by the late director, will be completed by him, and reported upon in a paper under the joint authorship of Thomson and Carpenter.

THE RELATIVE POSITIONS OF THE SHIP, THE MESSENGER-WEIGHTS, THE TOGGLE (G), AND THE DREDGE (B, ETC.), AT DIFFERENT STAGES OF PAYING-OUT FROM THE CHALLENGER.

Work upon the Coelenterata is progressing at a satisfactory rate. The Alcyonarians are still unpublished, the work being in the hands of Prof. E. Percival Wright.

Professor Albert von Kölliker disposes of the Pennatulida in an essay of forty-one pages (vol. i., 41 p., 11. pl.), with 61 beautifully executed lithographic figures. The expedition brought home 38 species of 19 genera, of which 27 species and 7 genera were new to science. The author formerly believed the great majority of the Pennatulida to occur at depths

of 20 fathoms or less; but the number of deep-sea forms now known is nearly equal to that of the shore-species of shallow-water forms. The deep-water forms appear, however, to be almost absent from the Atlantic, the Pacific, and the south polar seas. The simpler forms of the Pennatulida, especially those with sessile polyps, inhabit the great depths. These, of which the Protoptilidae and Umbellulidae are the most numerous, are believed to be the oldest, 'the last remnants of an extinct primary creation;' and of them the Challenger discovered a large number of species, with a wide distribution. This conclusion of the author is of especial interest, since the presence of their less complex representatives in deep water has been shown to be the rule in other groups of invertebrates as well.

The report upon the Actiniaria, by Professor Richard Hertwig of Königsberg (vol. vi., 136 p., 14 pl.), is a very laborious and exhaustive piece of work; and the fulness of the descriptions of anatomical details, as well as the elaboration of the drawings, are causes of surprise, when one remembers that zoölogists have hitherto usually refused to work with shrivelled alcoholic preparations; unless, indeed, drawings have been made from the living animals. 39 species were examined, of which 30 were new. The reader shares with the author his manifest disappointment, that the study of this group suggests answers to so few of the questions which naturally arise. At the same time, we cannot fail to recognize the importance of the author's concluding remarks, in which he demonstrates that life in the great depths has a visible influence upon the organization of the Actiniae, especially in the form of the tentacles, and shows how the nature of the food of the deep-sea forms has probably favored the transformation of the long tentacles of the ordinary littoral forms into tubes, or even simple openings in the oral disk. In the diverse arrangement of the septa in deep-sea forms, he finds, also, an important indication; namely, that the diversity in the structure of the Anthozoa was formerly much greater than it is at present, and that the remains of this diversity have been more extensively preserved in the depths of the sea than in the shallow waters.

Professor Hertwig makes frequent allusions to the work of the American authorities Verrill and Couthouy; and to the attainments of the former, in this department of zoölogy, he pays a well-merited compliment.

Prof. Henry N. Moseley of Oxford has printed his report upon the corals, chiefly in the group Hydrocorallinae, Helioporidae, and Madreporaria, which is worked out with the author's customary skill and minuteness. Many valuable papers on the structure of corals, based upon Challenger material, have also been published by Professor Moseley in the *Philosophical transactions*, and elsewhere.

Professor Ernst Haeckel's paper on the deep-sea Medusae (vol. iv., 259 p., 32 pl.) is, in its first half, devoted to an elaborate discussion of the general morphology and histology and phylogeny of the Medusae, having special reference to the new morphological facts derived from his study of this collection. The essentials of this paper were embodied by the author in his 'System der Medusen,' published in 1879; and it has already been reviewed in *Science*, vol. i. p. 195.

Professor Allman prints the first instalment of his memoir on the Hydroida, which consists of a report upon the Plumularidae (vol. vii., 55 p., 20 pl.). The introductory remarks upon the general morphology are of great importance as bringing the subject up to the present standard of information. It is pleasant to note the appreciation with which the work of Mr. Fewkes is now and again referred to. Out of the 31 species referred to, 26 are new, and a number of genera are for the first time characterized. Professor Allman asserts, that, in tropical and sub-tropical regions, this group has its maximum in multiplicity of forms, in the size of the colonies, and in individual profusion. He also calls attention to the apparent existence of two centres of maximum plumularian development, — an eastern one, in the warm seas of the East-Indian archipelago; and a western one, in the waters which surround the West-Indian Islands, and bathe the eastern shores of central and equinoctial America, — centres which are nearly coincident with those of maximum development in the Chiroptera.

Dr. William B. Carpenter's memoir on the genus Orbitolites (vol. vii., 47 p., 8 pl.) contains a *résumé* of an investigation which has been carried on by this veteran in deep-sea research, extending over more than a third of a century. The discussion of the four species under examination occupies but a small portion of the paper, which really deals with the entire group of Foraminifera, and concludes with a 'Study of the theory of descent,' in which the power of natural selection to originate any varietal forms whatever is distinctly denied.

The report on the Calcarea, by N. Poljaeff, of the University of Odessa (vol. viii., 76 p.,

9 pl.), is in the main devoted to developing a new system of classification for the group, and to the criticism of Professor Haeckel's monograph, 'Die kalkschwämme.' 30 species were brought in by the Challenger, 23 of which were new. All these are elaborately described, and illustrated by most exquisite plates, chiefly drawn by the author. Mr. Poljaeff expresses the hope, "that the systematic arrangement of the group Calcarea, here proposed, will serve as a sufficiently sure basis for further investigations," — a hope which will be shared by all, but which in the present unsettled state of opinion among specialists in this department, and in view of the scarcity of material for investigation, is perhaps a trifle premature.

Other papers upon the Protozoa are promised, but are mostly far down in the list. The Hexactinellid sponges are assigned to Prof. F. E. Schulze; the Tetractinellidae, to Professor Solles; the Monactinellidae, to Mr. S. O. Ridley. Mr. H. B. Brady's paper on the Foraminifera, and Professor Haeckel's on the Radiolaria, will probably first be printed.

G. Brown Goode.

Smithsonian Institution.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

RECENT PROGRESS IN PHYSICS.[1]

After referring to what at first appeared a rather startling experiment, the holding of a meeting of the association outside of Great Britain, and to the undoubted pleasure and benefit the members would receive from their visit to Canada, Lord Rayleigh spoke of the loss the association had met in the death of Sir W. Siemens, and gave a brief account of Siemens's scientific work. He called attention to the fact that it is now some years since the presidential chair had been occupied by a physicist, and, while regretting that he should be called on to preside when the association met in a country of so great interest to the naturalists, he proposed to do the best he could by giving a sketch of the progress in late years of physical science.

It is one of the difficulties of the task, that subjects as distinct as mechanics, electricity, heat, optics, and acoustics, to say nothing of astronomy and meteorology, are included under physics. Any one of these may well occupy the lifelong attention of a man of science; and to be thoroughly conversant with all of them is more than can be expected of any one individual, and is probably incompatible with the devotion of much time and energy to the actual advancement of knowledge. Another difficulty incident to the task, which must be faced but cannot be overcome, is that of estimating rightly the value, and even the correctness, of recent work. It is not always that which seems at first the most important that proves in the end to be so. The history of science teems with examples of discoveries which attracted little notice at the time, but afterwards have taken root downwards, and borne much fruit upwards.

One of the most striking advances of recent years is in the production and application of electricity upon a large scale. The dynamo-machine is, indeed, founded upon discoveries of Faraday, now more than half a century old; but it has required the protracted labors of many inventors to bring it to its present high degree of efficiency. Looking back at the matter, it seems strange that progress should have been so slow, not merely in details of design, the elaboration of which must always require the experience of actual work, but with regard to the main features of the problem. It would almost seem as if the difficulty lay in want of faith. Long ago it was recognized that electricity derived from chemical action is (on a large scale) too expensive a source of mechanical power, notwithstanding the fact that (as proved by Joule in 1846) the conversion of electrical into mechanical work can be effected with great economy. From this it is an evident consequence that electricity may advantageously be obtained from mechanical power; and one cannot help thinking, that, if the fact had been borne steadily in mind, the development of the dynamo might have been much more rapid. But discoveries and inventions are apt to appear obvious, when regarded from the stand-point of accomplished fact; and he drew attention to the matter only to point the moral that we do well to push the attack persistently when we can be sure beforehand that the obstacles to be overcome are only difficulties of contrivance, and that we are not vainly fighting unawares against a law of nature.

The present development of electricity on a large scale depends, however, almost as much upon the incandescent lamp as upon the dynamo. The success of these lamps demands a very perfect vacuum, — not more than about one-millionth of the normal quantity of air should remain, — and it is interesting to recall, that, twenty years ago, such vacua were rare even in the laboratory of the physicist. It is pretty safe to say that these wonderful results would never have been accomplished had practical applications alone been in view. The way was prepared by an army of scientific men, whose main object was the advancement of knowledge, and who could scarcely have imagined that the processes which they elaborated would soon be in use on a commercial

[1] Address to the British association for the advancement of science at Montreal, Aug. 27, 1884, by the Right Hon. Lord Rayleigh, M.A., D.C.L., F.R.S., F.R.A.S., F.R.G.S., professor of experimental physics in the University of Cambridge, president of the association.

scale, and intrusted to the hands of ordinary workmen.

The requirements of practice react in the most healthy manner upon scientific electricity. Just as in former days the science received a stimulus from the application to telegraphy, under which every thing relating to measurement on a small scale acquired an importance and development for which we might otherwise have had long to wait, so now the requirements of electric lighting are giving rise to a new development of the art of measurement upon a large scale, which cannot fail to prove of scientific as well as practical importance. Mere change of scale may not at first appear a very important matter, but it is surprising how much modification it entails in the instruments, and in the processes of measurement. For instance: the resistance-coils on which the electrician relies, in dealing with currents whose maximum is a fraction of an ampère, fail altogether when it becomes a question of hundreds, not to say thousands, of ampères.

The powerful currents which are now at command constitute almost a new weapon in the hands of the physicist. Effects which in old days were rare, and difficult of observation, may now be produced at will on the most conspicuous scale. Consider, for a moment, Faraday's great discovery of the 'magnetization of light,' which Tyndall likens to the Weisshorn among mountains, as high, beautiful, and alone. It is even possible that it might have eluded altogether the penetration of Faraday, had he not been provided with a special quality of very heavy glass. At the present day these effects may be produced upon a scale that would have delighted their discoverer, a rotation of the plane of polarization through 180° being perfectly feasible. With the aid of modern appliances, Kundt and Röntgen in Germany, and H. Becquerel in France, have detected the rotation in gases and vapors, where, on account of its extreme smallness, it had previously escaped notice.

Reference was made to the importance the question of the magnetic saturation of iron was assuming in the discussion of the problems arising in connection with the dynamo-machines, and to the work of Rowland and Stoletow on the theory of the behavior of soft iron under varying magnetic conditions.

The introduction of powerful alternate-current machines by Siemens, Gordon, Ferranti, and others, is likely also to have a salutary effect in educating those so-called practical electricians whose ideas do not easily rise above ohms and volts. It has long been known, that, when the changes are sufficiently rapid, the phenomena are governed much more by induction, or electric inertia, than by mere resistance. On this principle, much may be explained that would otherwise seem paradoxical. To take a comparatively simple case, conceive an electro-magnet wound with two contiguous wires, upon which acts a given rapidly periodic electromotive force. If one wire only be used, a certain amount of heat is developed in the circuit. Suppose, now, that the second wire is brought into operation in parallel, — a proceeding equivalent to doubling the section of the original wire. An electrician accustomed only to constant currents would be sure to think that the heating-effect would be doubled by the change, as much heat being developed in each wire separately as was at first in the single wire; but such a conclusion would be entirely erroneous. The total current, being governed practically by the self-induction of the circuit, would not be augmented by the accession of the second wire; and the total heating-effect, so far from being doubled, would, in virtue of the superior conductivity, be halved.

During the last few years, much interest has been felt in the reduction to an absolute standard of measurement of electromotive force, current, resistance, etc.; and to this end many laborious investigations have been undertaken, some of the results being embodied in the resolves of the Conference of electricians assembled at Paris.

For the measurement of current strength, advantage may be taken of Faraday's law, that the quantity of metal decomposed in an electrolytic cell is proportional to the whole quantity of electricity that passes. The best metal for the purpose is silver, deposited from a solution of the nitrate or of the chlorate. The results recently obtained by Professor Kohlrausch and by Lord Rayleigh are in very good agreement; and the conclusion that one ampère, flowing for one hour, decomposes 4.025 grains of silver, can hardly be in error by more than a thousandth part. This number being known, the silver voltameter gives a ready and very accurate method of measuring currents of intensity, varying from a tenth of an ampère to four or five ampères.

The beautiful and mysterious phenomena attending the discharge of electricity in nearly vacuous spaces have been investigated and in some degree explained by De la Rue, Crookes, Schuster, Moulton, and the lamented Spottiswoode, as well as by various able foreign experimenters; and a remarkable observation by Hall of Baltimore, from which it appeared that the flow of electricity in a conducting-sheet was disturbed by magnetic force, has been the subject of much discussion.

Without doubt, the most important achievement of the older generation of scientific men has been the establishment and application of the great laws of thermo-dynamics, or, as it is often called, the mechanical theory of heat. The first law, which asserts that heat and mechanical work can be transformed one into the other at a certain fixed rate, is now well understood by every student of physics; and the number expressing the mechanical equivalent of heat resulting from the experiments of Joule has been confirmed by the researches of others, and especially of Rowland. But the second law, which practically is even more important than the first, is only now beginning to receive the full appreciation due to it. One reason of this may be found in a not unnatural confusion of ideas. Words do not always lend themselves readily to the demands that are made upon them by a growing science; and the almost unavoidable use of the word 'equivalent' in the state-

ment of the first law is partly responsible for the little attention that is given to the second, for the second law so far contradicts the usual statement of the first as to assert that equivalents of heat and work are not of equal value. While work can always be converted into heat, heat can only be converted into work under certain limitations. For every practical purpose, the work is worth the most; and, when we speak of equivalents, we use the word in the same sort of special sense as that in which chemists speak of equivalents of gold and iron. The second law teaches us that the real value of heat, as a source of mechanical power, depends upon the temperature of the body in which it resides: the hotter the body, in relation to its surroundings, the more available the heat.

In order to see the relations which obtain between the first and the second law of thermo-dynamics, it is only necessary for us to glance at the theory of the steam-engine. Not many years ago, calculations were plentiful, demonstrating the inefficiency of the steam-engine, on the basis of a comparison of the work actually got out of the engine with the mechanical equivalent of the heat supplied to the boiler. Such calculations took into account only the first law of thermo-dynamics, which deals with the equivalents of heat and work, and had very little bearing upon the practical question of efficiency, which requires us to have regard, also, to the second law. According to that law, the fraction of the total energy which can be converted into work, depends upon the relative temperatures of the boiler and condenser; and it is therefore manifest, that, as the temperature of the boiler cannot be raised indefinitely, it is impossible to utilize all the energy which, according to the first law of thermo-dynamics, is resident in the coal.

On a sounder view of the matter, the efficiency of the steam-engine is found to be so high that there is no great margin remaining for improvement. The higher initial temperature possible in the gas-engine opens out much wider possibilities; and many good judges look forward to a time when the steam-engine will have to give way to its younger rival.

To return to the theoretical question, we may say, with Sir W. Thomson, that, though energy cannot be destroyed, it ever tends to be dissipated, or to pass from more available to less available forms. No one who has grasped this principle can fail to recognize its immense importance in the system of the universe. Every change — chemical, thermal, or mechanical — which takes place, or can take place, in nature, does so at the cost of a certain amount of available energy. The foundations laid by Thomson now bear an edifice of no mean proportions, thanks to the labors of several physicists, among whom must be especially mentioned Willard Gibbs, and Helmholtz. The former has elaborated a theory of the equilibrium of heterogeneous substances, wide in its principles, and, we cannot doubt, far-reaching in its consequences. In a series of masterly papers, Helmholtz has developed the conception of *free energy*, with very important applications to the theory of the galvanic cell. He points out, that the mere tendency to solution bears, in some cases, no small proportion to the affinities more usually reckoned chemical, and contributes largely to the total electromotive force. Also, in England, Dr. Alder Wright has published some valuable experiments relating to the subject.

From the further study of electrolysis, we may expect to gain improved views as to the nature of the chemical reactions, and of the forces concerned in bringing them about. Lord Rayleigh did not consider himself qualified to speak on recent progress in general chemistry; but if he might, without presumption, venture a word of recommendation, it would be in favor of a more minute study of the simpler chemical phenomena.

Under the head of scientific mechanics, it is principally in relation to fluid motion that advances may be looked for. The important and highly practical work of the late Mr. Froude in relation to the propulsion of ships is, doubtless, known to most. Recognizing the fallacy of views widely held, as to the nature of the resistance to be overcome, he showed, that, in the case of fair-shaped bodies, we have to deal almost entirely with resistance dependent upon skin-friction; and, at high speeds, upon the generation of surface-waves, by which energy is carried off. Although Professor Stokes, and other mathematicians, had previously published calculations pointing to the same conclusion, there can be no doubt that the view generally entertained was very different. Mr. Froude's experiments have set the question at rest in a manner satisfactory to those who had little confidence in theoretical prevision. Although the magnitude of skin-friction varies with the smoothness of the surface, we have no reason to think that it would disappear at any degree of smoothness consistent with an ultimate molecular structure. That it is connected with fluid viscosity is evident enough, but the *modus operandi* is still obscure.

Some important work bearing upon the subject has recently been published by Prof. O. Reynolds, who has investigated the flow of water in tubes as dependent upon the velocity of motion, and upon the size of the bore. The laws of motion in capillary tubes, discovered experimentally by Poiseuille, are in complete harmony with theory. The resistance varies as the velocity, and depends in a direct manner upon the constant of viscosity. But, when we come to the larger pipes and higher velocities with which engineers usually have to deal, the theory which presupposes a regularly stratified motion evidently ceases to be applicable, and the problem becomes essentially identical with that of skin-friction in relation to ship-propulsion. Professor Reynolds has traced with much success the passage from the one state of things to the other, and has proved the applicability, under these complicated conditions, of the general laws of dynamical similarity, as adapted to viscous fluids by Professor Stokes.

As also closely connected with the mechanics of viscous fluids, an important series of experiments upon the friction of oiled surfaces, recently executed by Mr. Tower for the Institution of mechanical engineers, must not be overlooked. When the lubrica-

tion is adequate, the friction is found to be nearly independent of the load, and much smaller than is usually supposed, giving a coefficient as low as a thousandth. When the layer of oil is well formed, the pressure between the solid surfaces is really borne by the fluid; and the work lost is spent in shearing, that is, in causing one stratum of the oil to glide over another.

The nature of gaseous viscosity, as due to the diffusion of momentum, has been made clear by the theoretical and experimental researches of Maxwell. A flat disk, moving in its own plane between two parallel solid surfaces, without contact, is impeded by the necessity of shearing the intervening layers of gas; and the hinderance is proportional to the velocity of the motion and to the viscosity of the gas, so that, under similar circumstances, this effect may be taken as a measure, or rather definition, of the viscosity. From the dynamical theory of gases, to the development of which he contributed so much, Maxwell drew the startling conclusion that the viscosity of a gas should be independent of its density; that within wide limits the resistance to the moving disk should be scarcely diminished by pumping out the gas, so as to form a partial vacuum. Experiment fully confirmed this theoretical anticipation, — one of the most remarkable to be found in the whole history of science, — and proved that the swinging disk was retarded by the gas as much when the barometer stood at half an inch as when it stood at thirty inches. It was obvious, of course, that the law must have a limit; that at a certain point of exhaustion the gas must begin to lose its power; and Lord Rayleigh remembers discussing with Maxwell, soon after the publication of his experiments, the whereabouts of the point at which the gas would cease to produce its ordinary effect. His apparatus, however, was quite unsuited for high degrees of exhaustion; and the failure of the law was first observed by Kundt and Warburg, at pressures below one millimetre of mercury. Subsequently the matter has been thoroughly examined by Crookes, who extended his observations to the highest degrees of exhaustion, as measured by MacLeod's gauge. Perhaps the most remarkable results relate to hydrogen. From the atmospheric pressure of seven hundred and sixty millimetres, down to about half a millimetre of mercury, the viscosity is sensibly constant. From this point to the highest vacuum, in which less than a millionth of the original gas remains, the coefficient of viscosity drops down gradually to a small fraction of its original value.

Such an achievement as the prediction of Maxwell's law of viscosity has, of course, drawn increased attention to the dynamical theory of gases. At the same time, the theory presents serious difficulties; and we can but feel, that, while the electrical and optical properties of gases remain out of relation to the theory, no final judgment is possible.

In optics, attention has naturally centred upon the spectrum. By the use of special photographic methods, Abney has mapped out the peculiarities of the invisible rays lying beyond the red with such success that our knowledge of them begins to be comparable with that of those visible to the eye. Equally important work has been done by Langley, using a refined invention of his own, based upon the principle of Siemens's pyrometer. Interesting results have also been obtained by Becquerel, whose method is founded upon a curious action of the ultra-red rays in enfeebling the light emitted by phosphorescent substances. One of the most startling of Langley's conclusions relates to the influence of the atmosphere in modifying the quality of solar light. By the comparison of observations made through varying thicknesses of air, he shows that the atmospheric absorption tells most upon the light of high refrangibility; so that, to an eye situated outside the atmosphere, the sun would present a decidedly bluish tint.

Cornu has made use of the fact that the refrangibility of a ray of light is altered by a motion of the luminous body to or from the observer to determine whether a line is of solar or atmospheric origin. For this purpose a small image of the sun is thrown upon the slit of the spectroscope, and caused to vibrate two or three times a second, in such a manner that the light entering the instrument comes alternately from the advancing and retreating limbs. As the sun is itself in rotation, and thus the position of a solar spectral line is slightly different according as the light comes from the advancing or from the retreating limb, a line due to absorption within the sun appears to tremble, as the result of slight alternately opposite displacements. But, if the seat of the absorption be in the atmosphere, it is a matter of indifference from what part of the sun the light originally proceeds; and the line maintains its position in spite of the oscillation of the image upon the slit of the spectroscope.

The instrumental weapon of investigation, the spectroscope itself, has made important advances. The magnificent gratings of Rowland are a new power in the hands of the spectroscopists, and, as triumphs of mechanical art, seem to be little short of perfection.

The great optical constant, the velocity of light, has been the subject of three distinct investigations by Cornu, Michelson, and Forbes. As may be supposed, the matter is of no ordinary difficulty, and it is therefore not surprising that the agreement should be less decided than could be wished. From their observations, which were made by a modification of Fizeau's method of the toothed wheel, Young and Forbes drew the conclusion that the velocity of light *in vacuo* varies from color to color, to such an extent that the velocity of blue light is nearly two per cent greater than that of red light. Such a variation is quite opposed to existing theoretical notions, and could only be accepted on the strongest evidence. Mr. Michelson, whose method (that of Foucault) is well suited to bring into prominence a variation of velocity with wave-length, has recently repeated his experiments with special reference to the point in question, and has arrived at the conclusion that no variation exists, comparable with that asserted by Young and Forbes. The actual velocity differs little

from that found from his first series of experiments, and may be taken to be 299,800 kilometres per second.

It is remarkable how many of the playthings of our childhood give rise to questions of the deepest scientific interest. In spite of the admirable investigations of Plateau, it still remains a mystery why soapy water stands almost alone among fluids as a material for bubbles. The beautiful development of color was long ago ascribed to the interference of light, called into play by the gradual thinning of the film. Some of the phenomena are, however, so curious as to have led excellent observers like Brewster to reject the theory of thin plates, and to assume the secretion of various kinds of coloring-matter.

When the thickness of a film falls below a small fraction of the length of a wave of light, the color disappears, and is replaced by an intense blackness. Professors Reinold and Rücker have recently made the remarkable observation, that the whole of the black region, soon after its formation, is of uniform thickness, the passage from the black to the colored portions being exceedingly abrupt. By two independent methods, they have determined the thickness of the black film to lie between seven and fourteen millionths of a millimetre; so that the thinnest films correspond to about one-seventieth of a wave-length of light. The importance of these results in regard to molecular theory is too obvious to be insisted upon.

In theoretical acoustics, progress has been steadily maintained, and many phenomena which were obscure twenty or thirty years ago, have since received adequate explanation. If some important practical questions remain unsolved, one reason is that they have not yet been definitely stated. Almost every thing in connection with the ordinary use of our senses presents peculiar difficulties to scientific investigation. Some kinds of information with regard to their surroundings are of such paramount importance to successive generations of living beings, that they have learned to interpret indications, which, from a physical point of view, are of the slenderest character. Every day we are in the habit of recognizing, without much difficulty, the quarter from which a sound proceeds; but by what steps we attain that end has not yet been satisfactorily explained. It has been proved, that, when proper precautions are taken, we are unable to distinguish whether a pure tone (as from a vibrating tuning-fork held over a suitable resonator) comes to us from in front, or from behind. This is what might have been expected from an *a priori* point of view; but what would not have been expected is, that with almost any other sort of sound, from a clap of the hands to the clearest vowel-sound, the discrimination is not only possible, but easy and instinctive. In these cases it does not appear how the possession of two ears helps us, though there is some evidence that it does; and, even when sounds come to us from the right or left, the explanation of the ready discrimination which is then possible with pure tones is not so easy as might at first appear. We should be inclined to think that the sound was heard much more loudly with the ear that is turned towards than with the ear that is turned from it, and that in this way the direction was recognized. But, if we try the experiment, we find, that, at any rate with notes near the middle of the musical scale, the difference of loudness is by no means so very great. The wave-lengths of such notes are long enough, in relation to the dimensions of the head, to forbid the formation of any thing like a sound-shadow, in which the averted ear might be sheltered.

In concluding this imperfect survey of recent progress in physics, Lord Rayleigh said emphatically that much of great importance had been passed over altogether. He should have liked to speak of those far-reaching speculations, especially associated with the name of Maxwell, in which light is regarded as a disturbance in an electro-magnetic medium. Indeed, at one time, he had thought of taking the scientific work of Maxwell as the principal theme of his address. But, like most men of genius, Maxwell delighted in questions too obscure and difficult for hasty treatment; and thus, much of his work could hardly be considered upon such an occasion as the present. Maxwell's endeavor was always to keep the facts in the foreground; and to his influence, in conjunction with that of Thomson and Helmholtz, is largely due that elimination of unnecessary hypothesis which is one of the distinguishing characteristics of the science of the present day.

In speaking unfavorably of superfluous hypothesis, Lord Rayleigh did not wish to be misunderstood. Science is nothing without generalizations. Detached and ill-assorted facts are only raw material, and, in the absence of a theoretical solvent, have but little nutritive value. At the present time, and in some departments, the accumulation of material is so rapid that there is danger of indigestion. By a fiction as remarkable as any to be found in law, what has once been published, even though it be in the Russian language, is usually spoken of as 'known;' and it is often forgotten that the rediscovery in the library may be a more difficult and uncertain process than the first discovery in the laboratory. In this matter, we are greatly dependent upon annual reports and abstracts, issued principally in Germany, without which the search for the discoveries of a little-known author would be well-nigh hopeless. Much useful work has been done in this direction in connection with our association. Such critical reports as those upon hydro-dynamics, upon tides, and upon spectroscopy, guide the investigator to the points most requiring attention, and, in discussing past achievements, contribute in no small degree to future progress. But, though good work has been done, much yet remains to do.

In estimating the present position and prospects of experimental science, there is good ground for encouragement. The multiplication of laboratories gives to the younger generation opportunities such as have never existed before, and which excite the envy of those who have had to learn in middle life much that now forms part of an undergraduate course. As to the management of such institutions,

there is room for a healthy difference of opinion. For many kinds of original work, especially in connection with accurate measurement, there is need of expensive apparatus; and it is often difficult to persuade a student to do his best with imperfect appliances, when he knows that by other means a better result could be attained with greater facility. Nevertheless, it seems important to discourage too great reliance upon the instrument-maker. Much of the best original work has been done with the homeliest appliances; and the endeavor to turn to the best account the means that may be at hand develops ingenuity and resource more than the most elaborate determinations with ready-made instruments. There is danger, otherwise, that the experimental education of a plodding student should be too mechanical and artificial, so that he is puzzled by small changes of apparatus, much as many school-boys are puzzled by a transposition of the letters in a diagram of Euclid.

In closing, Lord Rayleigh touched on the 'Greek question,' or 'Greek and Latin question,' and tried to ease the fears of the good souls who fear some day to awake and find their souls are no longer their own, but have been made away with by some scientific investigator.

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

U. S. geological survey.

(Work proposed for the ensuing fiscal year.)

THE plans for work to be done during the year ending June 30, 1885, have been matured as follows, subject to the exigencies of the service:—

North Atlantic district. Topography.—The work done during the past year, in this district, by the authority of the secretary of the interior, will be continued under the general direction of Mr. Henry Gannett. Recognizing the value of the work in progress in Massachusetts, the governor recommended and the legislature appropriated a sum of forty thousand dollars, to be expended during three years—ten thousand the first year, and fifteen thousand during two succeeding years—for topographic work, to be done under the general direction of a commission appointed to co-operate with the geological survey. This commission consists of Hon. F. A. Walker, president of the Institute of technology, Prof. N. S. Shaler of Harvard college, and Assistant H. L. Whiting of the coast-survey. Four parties will be put in the field, in charge of Messrs. H. F. Walling, Anton Karl, J. D. Hoffman, and S. H. Bodfish respectively, assisted by Mr. W. G. Newman and others. The topographic work by the state of New Jersey having ceased, and the material having been transferred to the geological survey without expense to the United States, it is proposed that the topographical work be taken up by Mr. C. C. Vermeule, aided by competent assistants, under the general superintendence of Prof. George H. Cook, state geologist, who gives his services gratuitously for that purpose.

General geology.—General geological work will be carried on in New England under the direction of Prof. R. Pumpelly.

South Atlantic district. Topography.—The work begun in 1882 will be continued under the general direction of Mr. Gilbert Thompson. Six topographical parties will enter the field under Messrs. C. M. Yeates, Morris Bien, F. M. Pearson, W. A. Shumway, and one other; there will be also two triangulation parties, one under S. S. Gannett, with general assistants Messrs. Wilson, Blair, McKinney, Oyster, Hackett, Hayes, Wakefield, Niblack, Michler, and Harrison. The area it is proposed to survey includes that portion of the Appalachian region comprised in eastern Kentucky, south-western Virginia, western North Carolina, eastern Tennessee, north-western South Carolina and Georgia, and northern Alabama.

General geology.—This part of the work in this district will be in charge of Mr. G. K. Gilbert, assisted by Messrs. I. C. Russell, Ira Sayles, H. R. Geiger, J. C. White, and W. D. Johnson. The work begun in the District of Columbia will be suspended during the absence of parties in the field, but the geology will be extended by Mr. McGee through parts of Virginia and Maryland.

Southern Mississippi and Rocky Mountain district. Topography.—Excepting in Yellowstone National Park, the general direction of work in this district will be taken by A. H. Thompson. In Arizona two parties, under H. M. Wilson and A. P. Davis, will be assisted by Messrs. Holman, Wallace, Maher, and Chapman. In Texas, Mr. E. M. Douglas will direct the work, as will Mr. R. U. Goode, with Messrs. Hawkins and Ratcliff assisting, in parts of Kansas, Missouri, and Arkansas. Some astronomical work in this district will be executed by Mr. Robert S. Woodward, assisted by Bushrod Washington. In the Yellowstone National Park, Mr. J. H. Renshawe will remain in charge of the work, assisted by Ensigns Chase and Garrett and Mr. S. A. Aplin.

Geology.—Arnold Hague, assisted by Messrs. Iddings, Weed, Wright, and Davis, will carry on the geological survey of the Yellowstone Park.

Northern Mississippi and Rocky Mountain district. Geology.—The survey of the glacial formations in this district will be continued under Prof. T. C. Chamberlin, assisted by Messrs. Salisbury and Todd. General geological work in Michigan, Wisconsin, and Minnesota, will be continued, as heretofore, under the direction of Mr. R. D. Irving, assisted by Messrs. Chauvenet, Daniells, C. W. Hall, Vanhise, and Merriam. Dr. F. V. Hayden will re-enter upon his investigations of the geology of the Upper Missouri, assisted

by Dr. A. C. Peale. The extinct volcanoes of the Rocky Mountain and Cascade ranges will form the subject of continued study by Capt. C. E. Dutton, U.S.A., assisted by Messrs. Diller and Van Hoesen.

Economic geology. — The commissioner of Indian affairs having requested, and the secretary of the interior having directed it, an examination of the coal-lands of the Great Sioux reservation in Dakota will be made by Mr. Bailey Willis and assistants. In Colorado, especially in the Kokomo, Silver Cliff, and Denver districts, work will be continued by Mr. S. F. Emmons, assisted by Messrs. Cross, Dun, Eakins, Hillebrand, Rodgers, and Schonfarber.

District of the Pacific. Topography. — This work, which has been in progress for two years, will be in charge of Mark B. Kerr, assisted by Messrs. Ricksecker and Ahern. The topographical and geological survey, carried on under the auspices of the Northern Pacific railway in Montana and Washington Territory by Prof. R. Pumpelly, having been discontinued, the maps, field-notes, and material have, at his instance, been turned over to the U. S. geological survey. These explorations, covering some forty-two thousand square miles, will thus be utilized and made public on the standard scale of the survey.

Geology. — Dr. Becker, assisted by Messrs. Melville, Raborg, and Turner, will continue the geological exploration of the cinnabar deposits of California.

(General work of the survey.)

Statistics and economic geology. — Last year Mr. Albert Williams, jun., collected a large amount of mining statistics, which were issued under the title of the 'Mineral resources of the United States.' No volume published by the survey has been more eagerly sought for, or given more general satisfaction. It is proposed to issue one of these volumes yearly, thus bringing the mining statistics annually up to date.

Paleontology. Vertebrates. — The vertebrate paleontology of the north-west will be further investigated by Prof. O. C. Marsh, assisted by Messrs. Williston, Bostwick, Hermann, and Barbour. Invertebrates. — Dr. C. A. White, assisted by Messrs. J. B. Marcou, L. C. Johnson, and Frank Burns, will carry on investigations among mesozoic and tertiary forms. Mr. C. D. Walcott, with the assistance of Messrs. Cooper Curtice and J. W. Gentry, will investigate the paleozoic fauna. The work on the fossil lamellibranchiata, begun by Professor James Hall, will be promoted by the assistance of the survey. Paleobotany. — Dr. Newberry will continue his work on the fossil flora of the north-west, and Prof. W. M. Fontaine his researches on mesozoic botany; while general paleobotany will be in charge of Mr. Lester F. Ward, assisted by Mr. O. C. Ward.

Chemistry. — Since the organization of the laboratory of the survey, its work has grown enormously, almost precluding original investigations by the mass of economic questions demanding solution. The work will continue to be directed by Prof. F. W. Clarke, assisted by Messrs. Chatard, Gooch, Barns, Hallock, Manners, Whitfield, Erni, Chase, and Howard.

Forestry. — The work of mapping the forest districts of the United States will be continued under the direction of Mr. George W. Shutt.

Publications. — Mr. W. H. Holmes will continue to supervise the preparation of the illustrations of various kinds for the survey publications, on the satisfactory and artistic character of which so much depends. He will be assisted by qualified collaborators.

RECENT PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Academy of natural sciences, Philadelphia.

July 15. — Mr. Thomas Meehan remarked that in many composite flowers the pollen is ejected from the apex of the staminal tube, and it became a matter of interest to ascertain the mechanism by which this is accomplished. The flowers of Compositae are much frequented by pollen-collecting insects, honey-gatherers seldom resorting to them. It is difficult, therefore, to watch the flow of pollen in the open air, as it is collected by the insects as fast as it appears. Some flowers of Helianthus lenticularis Dougl. were gathered, and, for the purpose of study, placed in saucers of water in a room where insects could not disturb them. In this way it was observed, that, after the corolla tube had reached its full length, very early the following morning the staminal tube commenced to grow beyond the mouth of the corolla, and by about nine A.M. had extended to a distance of one-fourth the whole length of the latter. The pollen then commenced to emerge through the upper portion of the staminal tube, which, the stamens narrowing, left the apices free. During the day the pollen continued to pour out, until by nightfall a large amount had accumulated at the apex of the tube. The morning of the second day the arms of the pistil emerged, and commenced to expand; and at once the staminal tube commenced to descend. At the end of the third day the staminal tube had retired entirely within the tube of the corolla, and, with the pistil, had begun to wither. A careful examination shows, that, through the whole course, the column of united anthers remains entirely of the same length, the filaments only being elastic. These stretch fully one-half their length. They are attached to the tube of the corolla at the inflated portion, a short distance above the akene, and extend to about midway between this point and the end of the tubular portion at the base of the limb; but, when the anther-tube is extended, the filaments occupy the whole of the space. Thus pollen could fall on the stigma of the previous day's flower; but, as this is

already covered by its own, such a supply is hardly likely to be of much service: we may therefore say that the arrangements favor self-fertilization.

Philosophical society, Washington.

May 24. — Mr. H. H. Bates read a paper on the physical basis of phenomena. —— Professor Thomas Robinson spoke of the strata and timbering of the east shaft of the water-works extension. As an incident to the engineering-works for the increase of the water-supply of Washington, a shaft has been sunk through the superficial deposits in the vicinity of Howard university. Professor Robinson presented a complete record of the formations pierced by the shaft, and discussed, also, the peculiar method of timbering.

June 7. — Mr. G. K. Gilbert presented a plan for the subject-bibliography of North-American geologic literature; and Major J. W. Powell presented a slightly different plan for the same purpose. These plans proposed to establish at the outset a limited number of divisions of the subject-matter of the literature, and to simultaneously prepare a bibliography of each, the total number of bibliographies being about seventy-five. A long discussion ensued, in the course of which the plans were vigorously criticised by Dr. Billings, who maintained that any classification would be found to require continual modification, and would be ultimately unsatisfactory. He advocated the adoption of the subject-index method, and the accumulation of a large body of references before classification was attempted.

NOTES AND NEWS.

WE have much pleasure in presenting the readers of *Science* with a few facts relating to some of the more prominent members of the British association, who are expected to be present at the Montreal meeting.

The permanent general secretaries (honorary) are Capt. Douglas Galton and Mr. A. G. Vernon Harcourt. The former has held office for many years; and, in addition to a wide scientific culture, possesses a special knowledge of every thing relating to sanitary science, and hence has been much engaged in promoting the International health exhibition. He is a cousin of Mr. Francis Galton. Mr. Harcourt is a near relative of the home secretary of state, and is professor of chemistry at Christchurch college, Oxford. He has devoted special attention to the chemistry of gas-lighting. The secretary, and general executive officer of the association, is Prof. T. G. Bonney, who is now president of the Geological society of London. For many years he was fellow and tutor of St. John's college, Cambridge, but at present fills the chair of geology, etc., at University college, London. He is distinguished rather as a petrologist and mineralogist than as a paleontologist. The treasurer, Prof. A. W. Williamson, the distinguished chemist, is unable to attend this meeting; but his functions will be discharged by Professor Burdon Sanderson, Waynflete professor of physiology at Oxford, and one of the scientific advisers of the government. The president of the association for this year is the Right Hon. Lord Rayleigh, an account of whose life is given on another page.

Among the twelve vice-presidents are the Right Hon. Sir Lyon Playfair, Sir J. D. Hooker, and Prof. E. Frankland. Sir L. Playfair has been nominated as the president of the association for the Aberdeen meeting in 1885. Born in 1819, he very early took great interest in chemistry, and in 1858 was elected professor thereof in the University of Edinburgh, which he now represents in parliament. He rendered great services as special commissioner in charge of juries at the International exhibitions of 1851 and 1862. In 1873-74 he was postmaster-general, and from 1880 to 1883 was deputy-speaker of the house of commons, and chairman of committee of ways and means. A great authority on all educational questions, he is one of the very few members of parliament who are eminent in science. Sir J. Hooker, the director of Kew gardens, so famous for his investigations of the laws which govern plant-distribution, was president of the Royal society from 1873 to 1878, and of this association in 1868. In 1877 he accompanied the U.S. survey parties in Utah and Colorado. Dr. Frankland, born in 1825, was president of the Chemical society in 1871, and for many years has been connected with the government teaching of chemistry, his present office being that of professor of chemistry in the Normal school of science, South Kensington. Much of his work has been in connection with the Rivers' pollution commission.

Coming now to the presidents of sections, mathematics and physics (section A) will be under the guidance of Sir W. Thomson, who has been professor of mathematics in the University of Glasgow since 1846, at which time he was twenty-two years of age. His famous researches in thermo-dynamics and in magnetism, and his practical work in submarine telegraphy, scarcely need a reference here. He was knighted in 1866, on the successful completion of the Atlantic cable, and was president of the association in 1871. Chemistry (section B) will be presided over by Prof. H. E. Roscoe, who, since 1858, has been professor of chemistry in Owens college, Manchester. He is president of the Literary and philosophical society of Manchester, and vice-chancellor of the new Victoria university. He is also one of the Royal commission on technical instruction, and will be knighted for his services in that capacity. He was president of the Chemical society in 1880, and the first president of the new Society of chemical industry in 1881. Geology (section C) will have for its president Mr. W. T. Blanford, the secretary of the Geological society of London. Section D (biology) will be guided by Prof. H. N. Moseley, who made his scientific reputation as one of the naturalists of the Challenger deep-sea surveying expedition, and eventually succeeded Professor Rolleston in his chair at the University of Oxford. Gen. Sir Henry Lefroy, a distinguished scientific officer of the Royal artillery, will preside over section E (geography). He has recently pub-

lished a valuable contribution to terrestrial magnetism. Section F (economic science and statistics) will be presided over by Sir Richard Temple, who was superintendent of relief operations for the Bengal famine in 1874, and governor of the Bombay presidency from 1877 to 1880. The president of section G (engineering) will be Sir Frederick Bramwell, brother of Baron Bramwell, the distinguished judge. He is a member of the heavy ordnance committee, and is constantly consulted by the government on engineering questions. At this meeting, the science of anthropology, instead of being, as heretofore, a sub-section of D (biology), will be raised to the dignity of a section by itself; and over section H, Dr. E. B. Tylor, the famous anthropologist, will preside. Born in 1832, he has devoted his life to the study of the races of mankind, their history, languages, and civilization. He is president of the Anthropological society, and keeper of the Oxford university museum, succeeding there Prof. H. J. Smith, whose chair of mathematics has just been filled by Professor Sylvester.

Two evening lectures to the whole association will be given on Friday, Aug. 29, and Monday, Sept. 1, by Prof. O. J. Lodge and Rev. W. H. Dallinger. Dr. Lodge is professor of physics at University college, Liverpool, and is one of the most rising physicists of the day. The subject of his discourse is 'Dust,' to which he has devoted much attention of late. Rev. W. H. Dallinger is principal of the Wesley college, Sheffield, and one of the lecturers for the Gilchrist educational trust. His subject, on this occasion, is "The modern microscope in relation to the least and lowest forms of life," his researches on which, in connection with Dr. Drysdale of Liverpool, required enormous patience and perseverance to carry to a successful issue.

Within the limits of space allotted for this purpose, a few more names of those who are expected to be present, and to take part in the meeting, may be mentioned in alphabetical order: Prof. J. C. Adams, the Lowndean professor of astronomy in the University of Cambridge, widely known as the discoverer of the planet Neptune, from calculations of disturbances in the orbits of the other planets; Professor James Dewar, Jacksonian professor of natural and experimental philosophy at Cambridge, and Fullerian professor of chemistry at the Royal institution, London (the appointment held by Faraday), whose *collaborateurs* are Professors Liveing and McKendrick; Sir F. Evans, who succeeded Admiral Richards as the hydrographer to the British admiralty; Mr. James Glaisher, the veteran aeronaut and meteorologist, who in 1865 succeeded Admiral Fitzroy in the meteorological department of the board of trade; Professor Leone Levi, born in Italy, naturalized in England in 1847, who was the main promoter of the first (Liverpool) chamber of commerce in Britain, founded in 1849 — he is a great authority on international and commercial law; Dr. W. H. Perkin, president of the Chemical society of London, and also of the Society of chemical industry, who was the founder of the aniline-dye industry, and is now engaged in magneto-optical researches; Rev. S. J. Perry, director of Stonyhurst observatory since 1860, chief of the Kerguelen Island transit of Venus expedition of 1874, and of the Madagascar similar expedition of 1882; Prof. W. Chandler Roberts, chemist to the mint, and professor of metallurgy, etc., at the normal school of science, succeeding Dr. Percy — his researches on the physical properties of alloys are well known; Dr. P. L. Sclater, one of the secretaries of this association from 1877 to 1882, who since 1859 has been secretary of the Zoölogical society of London — he is specially known as an ornithologist; and Mr. Walter Weldon, who occupies a distinguished place among those who have striven to apply pure science to manufacturing problems, chiefly connected with the soda industry, with which, probably, no man is better acquainted — he preceded Dr. Perkin as president of the Society of chemical industry.

— A number of papers and abstracts have already been received for the mechanical section (D) of the American association; and a sufficient number, in addition, are expected from prominent gentlemen, to make sure that the sessions will be of unusual interest. In addition to the address of President R. H. Thurston, two papers have been promised by Prof. William A. Rodgers of Cambridge, in connection with his already celebrated labors on standard bars, perfect screws, etc. In the same connection, a paper will be read by J. A. Brashear of Pittsburgh, Penn., on the manipulation of optical surfaces. Other papers on connected subjects are expected; and it is suggested that at least one session be devoted to these papers, and discussions upon them. From Mr. Allan Stirling of New-York City, is promised 'The economy of the electric light;' and the engineer, Mr. W. A. Traill, of Portrush, Ireland, will explain the Giant's Causeway and Portrush electric tramway, and exhibit a working model of the same. A session may therefore be occupied with modern applications of electricity. Another session will be occupied with papers upon civil-engineering subjects, among which may be mentioned, "Three problems in river physics: 1°. The transportation of sediment, and the formation and removal of sand-bars; 2°. The flow of water in natural channels; 3°. The relation of levees to the low-water navigation of rivers;" by Professor Johnson of Washington university, St. Louis, Mo. Other papers announced are, 'The strength of cast-iron,' by J. A. Millar, secretary of the Institute of engineers and ship-builders, in Scotland; 'Driven wells,' by J. C. Hoadley of Boston; 'Belting,' by Professor Lanza of the Massachusetts institute of technology; 'Steam-cylinder condensation,' by Assistant-Professor Fisher; and 'Methods of teaching in mechanical engineering,' by Professor Alden of the Worcester free institute. It is hoped that there will be sufficient papers upon the last subject to devote a session thereto, and gentlemen interested are requested to come prepared to take active part in the discussions.

Professor Webb, the secretary of the section, may in future be addressed at the association headquarters in Philadelphia; and he requests that abstracts, and especially titles of papers, should be sent as soon as

possible to the permanent secretary, Prof. F. W. Putnam, Hotel Lafayette. Space has been provided for models and apparatus, and attention is directed to the reduced rates of transportation to and from Philadelphia.

— From the report of Lieut. W. P. Ray, U.S.N., in charge of branch hydrographic office, New Orleans, La., Aug. 9, we learn that Capt. C. W. Reed, of the City of Dallas, reports that all the captains cruising along the eastern edge of the bank of Yucatan and north-eastern part of Yucatan have been very much surprised at the absence of the usual northerly current during April, May, June, and July. There has been no perceptible current until the last three days. The sailing directions give one and a half to two and a half knots per hour for these months.

— The Navy department has ordered Commander W. T. Sampson and Lieut. Commander T. F. Jewell to Montreal, in attendance on the British association for the advancement of science, and Lieut. Commander Jewell to Philadelphia during the meeting of the American association.

— The U. S. geological survey has recently published two topographical sheets of north-eastern Arizona, and one of north-western New Mexico, crossed by the line of the Atlantic and Pacific railroad, — the work of surveys in 1881, 1882, and 1883, by Messrs. Gilbert Thompson, A. H. Thompson, and their subordinates. The scale is 1 : 250,000, with contours every two hundred feet. The region included is of relatively simple plateau structure, complicated by volcanic action that has built cones and spread out lava-beds, and by the erosion of irregularly branching cañons which in several places have a remarkable resemblance to the veins of a maple-leaf. Most of the stream-courses are now dry, and serve as well-enclosed trails between the scattered settlements. Shallow lakes and pools are not uncommon, and springs are marked at the heads of small ravines; but their waters soon disappear in the sand below. Many Indian villages and ruins are mapped, including the Zuni towns on the Mesas, and the cliff dwellings of the Cañons de Chelly and del Muerto. The lettering is not so good as it should be, that of the legend of the plates being about as bad as possible, and the spelling of some of the Spanish names is certainly un-Spanish. The artistic execution reflects no credit upon the survey, being far below the standard gained in recent years.

— The thirty-ninth volume of the Mémoires of the topographic section of the Russian general staff has recently appeared in St. Petersburg. Its contents comprise, among other important papers, a report by Lebedeff on the Bessarabian triangulation. As the author's work is connected with the general triangulation of the empire, it has been taken in hand with the view, among other things, of calculating the difference of level between the Black and Baltic Seas. The result, however, is subject to too large a probable error to have more than an experimental interest; but a levelling recently executed has proved that there is no sensible difference of level between the Black Sea at Odessa and the Baltic at Libava.

A topographical exploration of northern Khorassan and southern Turcomania, with the astronomical data furnished by Gladysheff, has permitted the construction of an excellent map of this region on a scale of 1 : 210,000. Farther to the east, Arkhipoff has established the course of the routes leading from Karchi and Bukhara to Kilif and Charjui, along the Amu Daria.

The topography of the country between the Altai Mountains and the valley of the Upper Irtish, along the Russo-Chinese frontier, has been recently the subject of extensive exploration, a sound basis being afforded for the work by the astronomical observations of Miroshnichenko.

Triangulation has recently been carried on between Vladivostok and the Amur on a line between the Ussuri River and the west flanks of the Sikhota Mountains. In the same province, by surveys along the Russo-Chinese frontier, a termination has been put to the uncertainty in regard to the boundary which has so long interfered with the proper administration of justice and collection of taxes.

— Great preparations are being made for the exhibition of goldsmiths' work, to be held next year in the ancient town of Nuremberg. Exhibits are to be duty free; and a lottery, of which the prizes will be exhibits, will be held, and a guaranty fund of fifty thousand pounds has been subscribed. Indian and Persian work is expected; Japanese, promised. America, Spain, and Portugal have shown their sympathy with the undertaking; and France, Italy, Belgium, and Austria are already represented. The historical department is expected to be of considerable scientific interest.

— Letters received from Prjevalski announce his arrival at Alashan in January, 1884, after having crossed Mongolia without accident. No one was ill, though the mercury had frozen several times during the journey. At present the explorers should be in Thibet, or at least in Tzaïdam.

— The principal results of the meteorological station in Novaia Zemlia have been made public. The coldest monthly mean was that of January, 1883 (about −2° F.); but the thermometer indicated −61° F. on several occasions. The north-east and north-west winds were extremely violent, and being always accompanied by drifting snow, and sudden in springing up, were dangerous for any of the party who might be away from the station.

— The fall of a meteor near Odessa was recently reported to the French academy. It seems, that as the track of the meteor, as seen from the city, made it probable that it must have fallen near by, a reward was offered by one of the local papers for its discovery, which was responded to by a peasant who had seen it fall in the field where he was at work. It proved to be a shapeless mass of about eighteen pounds.

SCIENCE.

FRIDAY, SEPTEMBER 5, 1884.

[A]MERICAN ASSOCIATION MEETING IN PHILADELPHIA.

[...]lecting Philadelphia as the place of its [...] in 1884, the American association for [...]ancement of science has returned to its [...]ce. Forty-four years ago, a score of [...]sts — one of whom, James Hall, still [...] honor and vigor — assembled in the [...]f the academy of sciences, and formed [...]sociation of geologists and naturalists. [...]ears later, in Boston, it was decided to [...] this association; and so at another [...] in Philadelphia, on the 20th of Sep-[...], 1848, under the guidance of a leader [...]s but lately departed, — the beloved [...] B. Rogers, — a new constitution was [...], other scientific professors and workers [...]listed, and the association, as we now [...] in its catholic comprehensiveness, was [...]d upon its course.

[...]new name and the new form were doubt-[...]gested by the British association, which [...]s origin from the meeting at York in [...] The object of the American society was [...]d to be, "by periodical and migratory [...]s to promote intercourse between those [...] cultivating science in different parts of [...]ted States; to give a stronger and more [...] impulse and a more systematic direc-[...] scientific research in our country; and [...]re for the labors of scientific men in-[...] facilities and a wider usefulness." [...]ently the scope of the society was [...]d, and 'America' took the place of [...] States.'

[...]ain re-assembling at Philadelphia, when [...]s reversed the digits from '48 to '84, [...]tural to consider how far the purposes [...]ounders have been fulfilled. The most [...]e among them could not have antici-[...]uch a growth of scientific endowments, [...]eriod of one generation, as we now look back upon. The museums, the laboratories, the surveys, the observatories, the professorships, the schools of science and technology, which have been established and maintained since the association was formed, not only in the east but in the west, are results which, perhaps, may not be directly attributed to the association, but which certainly would never have been secured without a wide diffusion of scientific enthusiasm, such as usually follows these migratory congresses of investigators and teachers. We are among those who believe, that, if it could be shown that the association does nothing for the intellectual advantage of its members, nevertheless, all the efforts expended in its management are rewarded like the labors of the sowers in the springtime. The seed springs up, 'some ten, some sixty, some a hundred fold.' The educated people in every community, whether they are specially interested in science or not, are always attracted to the meetings; and the reports of papers and addresses are read far and wide through the land. Impressions are thus made in respect to the importance of different lines of research; and the names of scientific leaders become known to those who would never enter the dens and caves of the specialists, and would never have the benefit of their inspiration were it not for these autumnal conferences.

Rarely is there a meeting of the association which does not afford striking examples of the relations of government to science, and of the importance of securing for the public the results of prolonged research. Astronomy, geology, geodesy, certain branches of physics, ethnology, and now biology, through the admirable studies of the U. S. fish-commission, receive their most generous encouragement from the national government. To make the same assertion in another form, we may say that an enlightened people insists upon it that congress shall secure, for the good of all citizens, whatever results can be obtained by the liberal employment of

science in the public service. More than this, individual citizens have discovered that there is no better use for wealth than by endowments like those which are annually added to the educational resources of the country. In aiding all such tendencies, the American association has performed a noble part.

As we have seen, the founders of the association declared as their first object the promotion of "intercourse between those who are cultivating science in different parts of the United States." One of the obstacles to progress in this country is the wide separation of those who are workers in kindred departments. A professor in Dublin or in Edinburgh may go to London in a night; but it takes seven days for our California friends, and half that time for many a professor in the interior, to reach Washington or Boston. So much the more reason is there that these annual congresses, bringing people together from every part of the land, should be kept up. Acquaintances, friendships, copartnerships, promotions, criticisms, suggestions, assistance, are the fruits of this intercourse. Those who live in the centre of scientific activities, who see more people of mark in every month than are to be seen at other places in a year, are in danger of undervaluing all popular assemblies and conventions, and are tempted to stay away from the unsatisfactory throng. But it has been fortunate that nearly all the most eminent members of the American association have been ready to attend these meetings frequently, if not invariably, and to give the encouragement of their presence, their counsel, and their friendly greetings, to those who were younger. Not to mention any who are living, was there ever a more benignant and inspiring teacher than Agassiz? did any one ever forget the greetings of Bache who once felt his friendly grasp? and could anybody be more ready than Henry to lend a helpful hand to all who needed encouragement? Are there not scores of workers in the field to-day who remember with gratitude this trio, and others of their kin, as they appeared, for instance, at the Albany meeting when the association was in the first flush of its youthful vigor? Are there not like recollections of the great assembly of 1880, when Boston and Cambridge gave such admirable facilities for seeing institutions and men?

It seems to us that there is always danger of so multiplying the number of meetings, and of so subdividing the sections, as to confuse the members of the association, detract from the general interest, and interfere with the exchange of personal courtesies. The remedy lies with the officers of the association, preventing with firm and judicious decisions the reading of poor papers, and cutting off the discussions of wordy and rambling speakers. A few able papers are much better worth the consideration of the association than a multitude of unimportant communications. *Ponderanda non numeranda.*

As we write these lines, the meeting has not begun; but the circulars which have been issued show that every thing has been done in Philadelphia which experience in hospitality can suggest for the pleasure of the association. We trust that the reflex influences of the gathering will be felt upon the new institute of biology, on the great schools of medicine, on the University of Pennsylvania, on the Academy of natural sciences, and on all the other scientific foundations of which the city is justly proud. The seat of the American philosophical society is a shrine which the countrymen of Franklin and Rittenhouse will visit with pleasure under the presidency of Lesley.

J. PETER LESLEY.

The subject of this notice was born Sept. 17, 1819, in Philadelphia. Both his grandfather and father were cabinet-makers, intelligent, strong, and honest men, who brought up large families in the faith of the Church of Scotland, and in a love for hard work of every kind, physical and intellectual. He was sent to school on his sixth birthday, to the academy on his twelfth, and to the University of Pennsylvania on his fifteenth, getting his diploma in 1838. At an early age, his religious experiences were of the severest type. He knew

the Bible, especially the Old Testament, almost by heart; had read Bunyan's 'Pilgrim's progress' scores of times, and 'Robinson Crusoe' still oftener; went three times to church every Sunday, and twice to Sabbath school; and was in the best trim for becoming a candidate for the ministry, to which, in fact, he had been secretly dedicated from his birth. The family physician, however, refused to permit him to enter Princeton seminary after graduating from college; and an accident threw into his lap a commission as sub-assistant on the Geological survey of Pennsylvania, under the direction of Prof. Henry D. Rogers, so that it was only in the autumn of 1841 that he commenced his theological studies at Princeton, N.J.

He early announced his intention not to apply for ordination, but to spend his ministry among the castaway people of the Alleghany Mountains, with whose wretched spiritual condition he had become acquainted in the course of his geological surveys. To give himself a closer and deeper view into the character of the descendants of the original immigrants to Pennsylvania, he sailed from New York to Liverpool as a steerage passenger in 1844, walked through England and around France with a knapsack and blouse, visited the Waldenses of Dauphine and the Pietists in Geneva, crossed the Jura on foot, and middle Germany, and spent the winter months with Tholuck at the university at Halle, returning in a sailing-vessel from Bremen to Philadelphia the following May. He spent the next two years in the mountain-districts of the state, until his naturally vigorous constitution gave way, under incessant mental excitement, bodily fatigue and exposure.

A long illness ensued; but late in 1848 the worn-out missionary became the salaried pastor of an Orthodox-Congregationalist church near Boston, and continued in that capacity three years, when, bidding farewell to his parish and to theology, he returned to his native place and natural science, to commence life anew.

The next ten years were the most active of his life, most of the time being spent in the field. In 1856 he published a "Manual of coal and its topography, illustrated by original drawings, chiefly of facts in the geology of the Appalachian region of the United States," and was appointed secretary of the American iron association. In 1859 appeared his "Iron manufacturer's guide to furnaces, forges, and rolling-mills of the United States, with discussions of iron as a chemical element, an American ore, and a manufactured article, in commerce and in history." Jan. 15, 1858, while examining the iron-works of southern Ohio, Mr. Lesley was elected librarian, and Jan. 7, 1859, one of the four secretaries of the American philosophical society, and continues to hold these offices, which, for the first year or two, withdrew him almost entirely from field-work. From 1860 to 1866 Mr. Lesley was busily employed by capitalists to pronounce upon projected mining-plants, and by mine-owners to examine their properties, the call for iron and coal being great on account of the civil war. In 1864 and 1865 serious illnesses, produced by overwork, prepared the way for a complete breakdown of his nervous system in the early summer of 1866, from which he did not recover until the early winter of 1869, this interval of three years and a half being spent mostly in Europe.

Mr. Lesley went from Italy to the Paris exposition of 1867 as one of the ten commissioners appointed by the United States senate; but his illness steadily increased, and he was compelled to abandon his duties. Not until 1872 could he again do six hours of hard work a day; and a new career of usefulness was opened to him by his appointment, in that year, to the professorship of geology in the new department of science of the University of Pennsylvania, and in 1873 to the directorship of the Second geological survey of the state, still in progress. For four years (1873–78) he performed the duties of both offices, finding his only relaxation in a short voyage to Europe every two years; but a threatening recurrence of his former malady induced him to offer his resignation to the trustees of the university, who, however, preferred to grant him an indefinite furlough, until the close of the geological survey.

With what untiring zeal he has devoted himself to the work of that survey is only known to those who have been associated with him in the work. How successfully he has conducted it, is shown to the world through the seventy volumes recording its progress. If his hundreds of papers, scientific and literary, read before the American philosophical society, had never been published, this great work alone would place him in the front rank of American geologists. Of the personal character of a man whose modesty is his most prominent trait, it is difficult to speak as one would wish during his life.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PENDING PROBLEMS OF ASTRONOMY.[1]

Thirty-six years ago this very month, in this city, and near the place where we are now assembled, the American association for the advancement of science was organized, and held its first meeting. Now, for the first time, it revisits its honored birthplace.

Few of those present this evening were, I suppose, in attendance upon that first meeting. Here and there, among the members of the association, I see, indeed, the venerable faces of one and another, who, at that time in the flush and vigor of early manhood, participated in its proceedings and discussions; and there are others, who, as boys or youths, looked on in silence, and listening to the words of Agassiz and Peirce, of Bache and Henry, and the Rogers brothers and their associates, drank in that inspiring love of truth and science which ever since has guided and impelled their lives. Probably enough, too, there may be among our hosts in the audience a few who remember that occasion, and were present as spectators.

[1] Address to the American association for the advancement of science at Philadelphia, Sept. 5, 1884, by Prof. C. A. Young, professor of astronomy at Princeton, retiring president of the association.

substantially, we who meet here to-day are a neration, more numerous certainly, and in respects unquestionably better equipped for ork, than our predecessors were; though we not care to challenge comparisons as regards ability, or clearness of insight, or lofty pur-

the face of science has greatly changed in the ime; as much, perhaps, as this great city and tion. One might almost say, that, since 1848, ngs have become new' in the scientific world. is a new mathematics and a new astronomy, chemistry and a new electricity, a new geology new biology. Great voices have spoken, and ansformed the world of thought and research h as the material products of science have the aspects of external life. The telegraph namo-machine have not more changed the ons of business and industry than the specu- of Darwin and Helmholtz and their compeers fected those of philosophy and science.

although this return to our birthplace sug- etrospections and comparisons which might ly occupy our attention for even a much time than this evening's session, I prefer, on ole, to take a different course; looking for- rather than backwards, and confining myself to topics which lie along the pathway of my e of work.

voyager upon the inland sea of Japan sees ally rising before him new islands and moun- f that fairyland. Some come out suddenly ehind nearer rocks or islets, which long con- the greater things beyond; and some are veiled ds which give no hint of what they hide, until e rolls back the curtain; some, and the great- them all, are first seen as the minutest specks e horizon, and grow slowly to their final gran- Even before they reach the horizon line, while isible, they sometimes intimate their presence s in sky and air; so slight, indeed, that only ctised eye of the skilful sailor can detect them, quite obvious to him.

what so, as we look forward into the future ence, we see new problems and great subjects ing themselves. Some are imminent and in y, — they must be dealt with at once, before progress can be made; others are more re- interesting in various degrees; and some, as mere suggestions, almost too misty and in- for steady contemplation.

your permission, I propose this evening to r some of the pending problems of astronomy, which seem to be most pressing, and most y require solution as a condition of advance; se which appear in themselves most interest- likely to be fruitful, from a philosophic point .

g first those that lie nearest, we have the s which relate to the dimensions and figure earth, the uniformity of its diurnal rotation, constancy of its poles and axis.

k the impression prevails, that we already know the earth's dimensions with an accuracy even greater than that required by any *astronomical* demands. I certainly had that impression myself not long ago, and was a little startled on being told by the superintendent of our Nautical almanac that the remaining uncertainty was still sufficient to produce serious embarrassment in the reduction and comparison of certain lunar observations. The length of the line joining, say, the Naval observatory at Washington with the Royal observatory at the Cape of Good Hope, is doubtful; not to the extent of only a few hundred feet, as commonly supposed, but the uncertainty amounts to some thousands of feet, and may possibly be a mile or more, probably not less than a ten-thousandth of the whole distance; and the *direction* of the line is uncertain in about the same degree. Of course, on those portions of either continent which have been directly connected with each other by geodetic triangulations, no corresponding uncertainty obtains; and as time goes on, and these surveys are extended, the form and dimensions of each continuous land-surface will become more and more perfectly determined. But at present we have no satisfactory means of obtaining the desired accuracy in the relative position of places separated by oceans, so that they cannot be connected by chains of triangulation. Astronomical determinations of latitude and longitude do not meet the case; since, in the last analysis, they only give at any selected station the *direction of gravity* relative to the axis of the earth, and some fixed meridian plane, and do not furnish any *linear* measurement or dimension.

Of course, if the surface of the earth were an exact spheroid, and if there were no irregular attractions due to mountains and valleys and the varying density of strata, the difficulty could be easily evaded; but, as the matter stands, it looks as if nothing short of a complete geodetic triangulation of the whole earth would ever answer the purpose, — a triangulation covering Asia and Africa, as well as Europe, and brought into America by way of Siberia and Bering Strait.

It is indeed theoretically possible, and just conceivable, that the problem may some day be reversed, and that the geodesist may come to owe some of his most important data to the observers of the lunar motions. When the relative position of two or more remote observatories shall have been precisely determined by triangulation (for instance, Greenwich, Madras, and the Cape of Good Hope), and when, by improved methods and observations made at these fundamental stations, the moon's position and motion relative to them shall have been determined with an accuracy much exceeding any thing now attainable, then by similar observations, made simultaneously at any station in this hemisphere, it will be theoretically possible to determine the position of this station, and so, by way of the moon, to bridge the ocean, and ascertain how other stations are related to those which were taken as primary. I do not, of course, mean to imply, that, in the *present state* of observational astronomy, any such procedure would lead to results of much value; but, before the Asiatic

triangulation meets the American at Bering Strait, it is not unlikely that the accuracy of lunar observations will be greatly increased.

The present uncertainty as to the earth's dimensions is not, however, a sensible embarrassment to astronomers, except in dealing with the moon, especially in attempting to employ observations made at remote and ocean-separated stations for the determination of her parallax.

As to the form of the earth, it seems pretty evident that before long it will be wise to give up further attempts to determine exactly what spheroid or ellipsoid *most nearly corresponds* to the actual figure of the earth; since every new continental survey will require a modification of the elements of this spheroid in order to take account of the new data. It will be better to assume some closely approximate spheroid *as a finality;* its elements to be forever retained unchanged, while the deviations of the actual surface from this ideal standard will be the subject of continued investigation and measurement.

A more important and anxious question of the modern astronomer is, Is the earth's rotation uniform, and, if not, in what way and to what extent does it vary? The importance, of course, lies in the fact that this rotation furnishes our fundamental measure and unit of time.

Up to a comparatively recent date, there has not been reason to suspect this unit of any variation sufficient to be detected by human observation. It has long been perceived, of course, that any changes in the earth's form or dimensions must alter the length of the day. The displacement of the surface or strata by earthquakes or by more gradual elevation and subsidence, the transportation of matter towards or from the equator by rivers or ocean currents, the accumulation or removal of ice in the polar regions or on mountain-tops, — any such causes must necessarily produce a real effect. So, also, must the friction of tides and trade-winds. But it has been supposed that these effects were so minute, and to such an extent mutually compensatory, as to be quite beyond the reach of observation; nor is it yet certain that they are not. All that can be said is, that it is now beginning to be *questionable* whether they are, or are not.

The reason for suspecting perceptible variation in the earth's revolution, lies mainly in certain unexplained irregularities in the apparent motions of the moon. She alone, of all the heavenly bodies, changes her place in the sky so rapidly, that minute inaccuracies of a second or two in the time of observation would lead to sensible discrepancies in the observed position; an error of one second, in the time, corresponding to about half a second in her place, — a quantity minute, certainly, but perfectly observable. No other heavenly body has an apparent movement anywhere nearly as rapid, excepting only the inner satellite of Mars; and this body is so minute that its accurate observation is impracticable, except with the largest telescopes, and at the times when Mars is unusually near the earth.

Now, of late, the motions of the moon have been very carefully investigated, both theoretically and observationally; and, in spite of every thing, there remain discrepancies which defy explanation. We are compelled to admit one of three things, — either the lunar theory is in some degree mathematically incomplete, and fails to represent accurately the gravitational action of the earth and sun, and other known heavenly bodies, upon her movements; or some unknown force other than the gravitational attractions of these bodies is operating in the case; or else, finally, the earth's rotational motion is more or less irregular, and so affects the time-reckoning, and confounds prediction.

If the last is really the case, it is in some sense a most discouraging fact, necessarily putting a limit to the accuracy of all prediction, unless some other unchanging and convenient measure of time shall be found to replace the 'day' and 'second.'

The question at once presents itself, How can the constancy of the day be tested? The lunar motions furnish grounds of suspicion, but nothing more; since it is at least as likely that the mathematical theory is minutely incorrect or incomplete as that the day is sensibly variable.

Up to the present time, the most effective tests suggested are from the transits of Mercury and from the eclipses of Jupiter's satellites. On the whole, the result of Professor Newcomb's elaborate and exhaustive investigation of all the observed transits, together with all the available eclipses and occultations of stars, tends rather to establish the sensible constancy of the day, and to make it pretty certain (to use his own language) that "inequalities in the lunar motions, not accounted for by the theory of gravitation, really exist, and in such a way that the mean motion of the moon between 1800 and 1875 was really less (i.e., slower) than between 1720 and 1800." Until lately, the observations of Jupiter's satellites have not been made with sufficient accuracy to be of any use in settling so delicate a question; but at present the observation of their eclipses is being carried on at Cambridge, Mass., and elsewhere, by methods that promise a great increase of accuracy over any thing preceding. Of course, no *speedy* solution of the problem is possible through such observations, and their result will not be so free from mathematical complications as desirable, — complications arising from the mutual action of the satellites, and the ellipsoidal form of the planet. On account of its freedom from all sensible disturbances, the remote and lonely satellite of Neptune may possibly some time contribute useful data to the problem.

We have not time, and it lies outside my present scope, to discuss whether, and, if so, how, it may be possible to find a unit of time (and length) which shall be independent of the earth's conditions and dimensions (free from all *local considerations*), cosmical, and as applicable in the planetary system of the remotest star as in our own. At present we can postpone its consideration; but the time must unquestionably come, when the accuracy of scientific observation will be so far increased, that the irregularities of the earth's rotation, produced by the causes

o a few minutes ago, will protrude, and be-
olerable. Then a new unit of time will have
nd for scientific purposes, founded, perhaps,
een already suggested by many physicists,
vibrations or motion of light, or upon
er physical action which pervades the uni-

er problem of terrestrial astronomy relates
nstancy of the position of the earth's axis
obe. Just as displacements of matter upon
ce or in the interior of the earth would
changes in the time of rotation, so also
ey cause corresponding alterations in the
f the axis and in the places of the poles, —
certainly very minute. The only question
er they are so minute as to defy detection.
y to see that any such displacements of the
xis will be indicated by changes in the *lati-*
our observatories. If, for instance, the pole
ved a hundred feet from its present posi-
ards the continent of Europe, the latitudes
ean observatories would be increased about
nd, while in Asia and America the effects
trifling.

nly observational evidence of such move-
the pole, which thus far amounts to any
found in the results obtained by Nyren in
the determinations of the latitude of Pul-
ade with the great vertical circle, during the
ty-five years. They seem to show a slow,
minution of the latitude of this observatory,
ng to about a second in a century; as if the
e were drifting away, and increasing its dis-
m Pulkowa at the rate of about one foot a

reenwich and Paris observations do not
such result; but they are not conclusive,
nt of the difference of longitude, to say
f their inferior precision. The question is
a doubtful one; but it is considered of so
portance, that, at the meeting of the Inter-
geodetic association in Rome last year, a
n was adopted recommending observations
designed to settle it. The plan of Sig.
who introduced the resolution, is to select
stations, having nearly the same latitude,
ring widely in longitude, and to determine
rence of their latitudes by observations of
set of stars, observed with similar instru-
n the same manner, and reduced by the
thods and formulae. So far as possible, the
ervers are to be retained through a series of
d are frequently to exchange stations when
le, so as to eliminate personal equations.
n difficulty of the problem lies, of course,
inuteness of the effect to be detected; and
hope of success lies in the most scrupulous
precision in all the operations involved.

problems, relating to the rigidity of the earth
ternal constitution and temperature, have,
stronomical bearings, and may be reached
xtent by astronomical methods and consider-
ut they lie on the border of our science, and
time forbids any thing more than their mere mention
re.

we consider, next, the problems set us by the
oon, we find them numerous, important, and diffi-
cult. A portion of them are purely mathematical,
relating to her orbital motion; while others are phys-
ical, and have to do with her surface, atmosphere,
heat, etc.

As has been already intimated, the lunar theory is not in a satisfactory state. I do not mean, of course, that the moon's deviations from the predicted path are gross and palpable, — such, for instance, as could be perceived by the unaided eye (this I say for the benefit of those who otherwise might not understand how small a matter sets astronomers to grumbling); but they are large enough to be easily observable, and even obtrusive, amounting to several seconds of arc, or miles of space. As we have seen, the attempt to account for them by the irregularity of the earth's rotation has apparently failed; and we are driven to the conclusion, either that other forces than gravitation are operative upon the lunar motions, or else (what is far more probable, considering the past history of theoretical astronomy) that the mathematical theory is somewhere at fault.

To one looking at the matter a little from the outside, it seems as if that which is most needed just now, in order to secure the advance of science in many directions, is a new, more comprehensive, and more manageable solution of the fundamental equations of motion under attraction. Far be it from me to cry out against those mathematicians who delight themselves in transcendental and n-dimensional space, and revel in the theory of numbers, — we all know how unexpectedly discoveries and new ideas belonging to one field of science find use and application in widely different regions, — but I own, I feel much more interest in the study of the theory of functions and differential equations, and expect more aid for astronomy from it.

The problem of any number of bodies, moving under their mutual attraction, according to the Newtonian laws, stands, from a physical point of view, on precisely the same footing as that of *two* bodies. Given the masses, and the positions and velocities corresponding to any moment of time, then the whole configuration of the system for all time, past and future (abstracting outside forces, of course), is absolutely determinate, and amenable to calculation. But while, in the case of *two* bodies, the calculation is easy and feasible, by methods known for two hundred years, our analysis has not yet mastered the general problem for more than two. In special instances, by computations, tedious, indirect, and approximate, we can, indeed, carry our predictions forward over long periods, or indicate past conditions with any required degree of accuracy; but a general and universally practicable solution is yet wanting. The difficulties in the way are purely mathematical: a step needs to be taken, corresponding in importance to the introduction of the circular functions, into trigonometry, the invention of logarithms, or the discovery of the calculus. The problem confronts the

astronomer on a hundred different roads; and, until it is overcome, progress in these directions must be slow and painful. One could not truly say, perhaps, that the lunar theory must, in the mean while, remain quite at a standstill: labor expended in the old ways, upon the extension and development of existing methods, may not be fruitless, and may, perhaps, after a while, effect the reconcilement of prediction and observation far beyond the present limits of accuracy. But if we only had the mathematical powers we long for, then progress would be as by wings: we should fly, where now we crawl.

As to the physical problems presented by the moon, the questions relating to the light and heat — the radiant energy — it sends us, and to its temperature, seem to be the most attractive at present, especially for the reason that the results of the most recent investigators seem partially to contradict those obtained by their predecessors some years ago. It now looks as if we should have to admit that nearly all we receive from the moon is simply *reflected* sun-light and sun-heat, and that the temperature of the lunar surface nowhere rises as high as the freezing-point of water, or even of mercury. At the same time, some astronomers of reputation are not disposed to admit such an upsetting of long-received ideas; and it is quite certain, that, in the course of the next few years, the subject will be carefully and variously investigated.

Closely connected with this is the problem of a lunar atmosphere — if, indeed, she has any.

Then there is the very interesting discussion concerning changes upon the moon's surface. Considering the difference between our modern telescopes and those employed fifty or a hundred years ago, I think it still far from certain that the differences between the representations of earlier and later observers necessarily imply any real alterations. But they, no doubt, render it considerably *probable* that such alterations have occurred, and are still in progress; and they justify a persistent, careful, minute, and thorough study of the details of the lunar surface with powerful instruments: especially do they inculcate the value of large-scale photographs, which can be preserved for future comparison as unimpeachable witnesses.

I will not leave the moon without a word in respect to the remarkable speculations of Professor George Darwin concerning the tidal evolution of our satellite. Without necessarily admitting all the numerical results as to her age and her past and future history, one may certainly say that he has given a most plausible and satisfactory explanation of the manner in which the present state of things might have come about through the operation of causes known and recognized, has opened a new field of research, and shown the way to new dominions. The introduction of the doctrine of the conservation of energy, as a means of establishing the conditions of motion and configuration in an astronomical system, is a very important step.

In the planetary system we meet, in the main, the same problems as those that relate to the moon, with a few cases of special interest.

For the most part, the accordance between theory and observation in the motions of the larger planets is as close as could be expected. The labors of Leverrier, Hill, Newcomb, and others, have so nearly cleared the field, that it seems likely that several decades will be needed to develop discrepancies sufficient to furnish any important corrections to our present tables. Leverrier himself, however, indicated one striking and significant exception to the general tractableness of the planets. Mercury, the nearest to the sun, and the one, therefore, which ought to be the best behaved of all, is rebellious to a certain extent: the perihelion of its orbit moves around the sun more rapidly than can be explained by the action of the other known planets. The evidence to this effect has been continually accumulating ever since Leverrier first announced the fact, some thirty years ago; and the recent investigation by Professor Newcomb, of the whole series of observed transits, puts the thing beyond question. Leverrier's own belief (in which he died) was, that the effect is due to an unknown planet or planets between Mercury and the sun; but, as things now stand, we think that any candid investigator must admit that the probability of the existence of any such body or bodies of considerable dimensions is vanishingly small. We do not forget the numerous instances of round spots seen on the solar disk, nor the eclipse-stars of Watson, Swift, Trouvelot, and others; but the demonstrated possibility of error or mistake in all these cases, and the tremendous array of negative evidence from the most trustworthy observers, with the best equipment and opportunity, makes it little short of certain that there is no Vulcan in the planetary system.

A ring of meteoric matter between the planet and the sun might account for the motion of the perihelion; but, as Newcomb has suggested, such a ring would also disturb the *nodes* of Mercury's orbit.

It has been surmised that the cause may be something in the distribution of matter within the solar globe, or some variation in gravitation from the exact law of the inverse square, or some supplementary electric or magnetic action of the sun, or some special effect of the solar radiation, sensible on account of the planet's proximity, or something peculiar to the region in which the planet moves; but as yet no satisfactory explanation has been established.

Speaking of unknown planets, we are rather reluctantly obliged to admit that it is a part of our scientific duty as astronomers to continue to search for the remaining asteroids; at least, I suppose so, although the family has already become embarrassingly large. Still I think we are likely to learn as much about the constitution, genesis, and history of the solar system from these little flying rocks as from their larger relatives; and the theory of perturbations will be forced to rapid growth in dealing with the effects of Jupiter and Saturn upon their motions.

Nor is it unlikely that some day the searcher for these insignificant little vagabonds may be rewarded by the discovery of some great world, as yet unknown, slow moving in the outer desolation beyond the re-

motest of the present planetary family. Some configurations in certain cometary orbits, and some almost evanescent peculiarities in Neptune's motions, have been thought to point to the existence of such a world; and there is no evidence, nor even a presumption, against it.

Mercury as yet defies all our attempts to ascertain the length of its day, and the character and condition of its surface. Apparently the instruments and methods now at command are insufficient to cope with the difficulties of the problem; and it is not easy to say how it can be successfully attacked.

With Venus, the earth's twin-sister, the state of things is a little better: we do already know, with some degree of approximation, her period of rotation; and the observations of the last few months bid fair, if followed up, to determine the position of her poles, and possibly to give us some knowledge of her mountains, continents, and seas.

It would be rash to say of Mars that we have reached the limit of possible knowledge as regards a planet's surface; but the main facts are now determined, and we have a rather surprising amount of supposed knowledge regarding his geography. By 'supposed' I mean merely to insinuate a modest doubt whether some of the map-makers have not gone into a little more elaborate detail than the circumstances warrant. At any rate, while the 'areographies' agree very well with each other in respect to the planet's more important features, they differ widely and irreconcilably in minor points.

As regards the physical features of the asteroids, we at present know practically nothing: the field is absolutely open. Whether it is worth any thing may be a question; and yet, if one *could* reach it, I am persuaded that a knowledge of the substance, form, density, rotation, temperature, and other physical characteristics, of one of these little orphans, would throw vivid light on the nature and behavior of interplanetary space, and would be of great use in establishing the physical theory of the solar system.

The planet Jupiter, lordliest of them all, still, as from the first, presents problems of the highest importance and interest. A sort of connecting-link between suns and planets, it seems as if, perhaps, we might find, in the beautiful and varied phenomena he exhibits, a kind of halfway house between familiar terrestrial facts and solar mysteries. It seems quite certain that no analogies drawn from the earth and the earth's atmosphere alone will explain the strange things seen upon his disk, some of which, especially the anomalous differences observed between the rotation periods derived from the observation of markings in different latitudes, are very similar to what we find upon the sun. 'The great red spot' which has just disappeared, after challenging for several years our best endeavors to understand and explain it, still, I think, remains as much a mystery as ever, — a mystery probably hiding within itself the master-key to the constitution of the great orb of whose inmost nature it was an outward and most characteristic expression. The same characteristics are also probably manifested in other less conspicuous but equally curious and interesting markings on the varied and ever-changing countenance of this planet; so that, like the moon, it will well repay the most minute and assiduous study.

Its satellite system also deserves careful observation, especially in respect to the eclipses which occur; since we find in them a measure of the time required for light to cross the orbit of the earth, and so of the solar parallax, and also because, as has been already mentioned, they furnish a test of the constancy of the earth's rotation. The photometric method of observing these eclipses, first instituted by Professor Pickering at Cambridge in 1878, and since re-invented by Cornu in Paris, has already much increased the precision of the results.

With reference to the mathematical theory of the motion of these satellites, the same remarks apply as to the planetary theory. As yet nothing appears in the problem to be beyond the power and scope of existing methods, when carried out with the necessary care and prolixity; but a new and more compendious method is most desirable.

The problems of Saturn are much the same as those of Jupiter, excepting that the surface and atmospheric phenomena are less striking, and more difficult of observation. But we have, in addition, the wonderful rings, unique in the heavens, the loveliest of all telescopic objects, the type and pattern, I suppose, of world-making, in actual progress before our eyes. There seems to be continually accumulating evidence from the observations of Struve, Dawes, Henry, and others, that these whirling clouds are changing in their dimensions and in the density of their different parts; and it is certainly the duty of every one who has a good telescope, a sharp eye, and a chastened imagination, to watch them carefully, and set down exactly what he sees. It may well be that even a few decades will develop most important and instructive phenomena in this gauzy girdle of old Chronos. Great care, however, is needed in order not to mistake fancies and illusions for solid facts. Not a few anomalous appearances have been described and commented on, which failed to be recognized by more cautious observers with less vivid imaginations, more trustworthy eyes, and better telescopes.

The outer planets, Uranus and Neptune, until recently, have defied all attempts to study their surface and physical characteristics. Their own motions and those of their satellites, have been well worked out; but it remains to discuss their rotation, topog-
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periods, on the one hand, and, on the other, the planets' distances from the sun, their diameters and masses. More than thirty years ago, Professor Kirkwood supposed that he had discovered the relation in the analogy which bears his name. The materials for testing and establishing it were then, however, insufficient, and still remain so, leaving far too many of the data uncertain and arbitrary. Could such a relation be discovered, it could hardly fail to have a most important significance with respect to theories of the origin and development of the planetary system.

The great problem of the absolute dimensions of our system is, of course, commanded by the special problem of the solar parallax; and this remains a problem still. Constant errors of one kind or another, the origin of which is still obscure, seem to affect the different methods of solution. Thus, while experiments upon the velocity of light and heliometric measurements of the displacements of Mars among the stars agree remarkably in assigning a smaller parallax (and greater distance of the sun) than seems to be indicated by the observations of the late transits of Venus, and by methods founded on the lunar motions, on the other hand, the meridian observations of Mars all point to a larger parallax and smaller distance. While still disposed to put more confidence in the methods first named, I, for one, must admit that the margin of probable error seems to me to have been rather increased than diminished by the latest published results deduced from the transits. I do not feel so confident of the correctness of the value 8″.80 for the solar parallax as I did three years ago. In its very nature, this problem is one, however, that astronomers can never have done with. So fundamental is it, that the time will never come when they can properly give up the attempt to increase the precision of their determination, and to test the received value by every new method that may be found.

The problems presented by the sun alone might themselves well occupy more than the time at our disposal this evening. Its mass, dimensions, and motions, as a whole, are, indeed, pretty well determined and understood; but when we come to questions relating to its constitution, the cause and nature of the appearances presented upon its surface, the periodicity of its spots, its temperature, and the maintenance of its heat, the extent of its atmosphere, and the nature of the corona, we find the most radical differences of opinion.

The difficulties of all solar problems are, of course, greatly enhanced by the enormous difference between solar conditions and the conditions attainable in our laboratories. We often reach, indeed, similarity sufficient to establish a bond of connection, and to afford a basis for speculation; but the dissimilarity remains so great as to render quantitative calculations unsafe, and make positive conclusions more or less insecure. We can pretty confidently infer the presence of iron and hydrogen and other elements in the sun by appearances which we can reproduce upon the earth; but we cannot safely apply empirical formulae (like that of Dulong and Petit, for instance), deduced from terrestrial experiments, to determine solar temperatures: such a proceeding is an unsound and unwarrantable extrapolation, likely to lead to widely erroneous conclusions.

For my own part, I feel satisfied as to the substantial correctness of the generally received theory of the sun's constitution, which regards this body as a great ball of intensely heated vapors and gases, clothed outwardly with a coat of dazzling clouds formed by the condensation of the less volatile substances into drops and crystals like rain and snow. Yet it must be acknowledged that this hypothesis is called in question by high authorities, who maintain, with Kirchoff and Zöllner, that the visible photosphere is no mere layer of clouds, but either a solid crust, or a liquid ocean of molten metals; and there may be some who continue to hold the view of the elder Herschel (still quoted as authoritative in numerous school-books), that the central core of the sun is a solid and even habitable globe, having the outer surface of its atmosphere covered with a sheet of flame maintained by some action of the matter diffused in the space through which the system is rushing. We must admit that the question of the sun's constitution is not yet beyond debate.

And not only the constitution of the sun itself, but the nature and condition of the matter composing it, is open to question. Have we to do with iron and sodium and hydrogen as we know them on the earth, or are the solar substances in some different and more elemental state?

However confident many of us may be as to the general theory of the constitution of the sun, very few, I imagine, would maintain that the full explanation of sun-spots and their behavoir has yet been reached. We meet continually with phenomena, which, if not really contradictory to prevalent ideas, at least do not find in them an easy explanation.

So far as mere visual appearances are concerned, I think it must be conceded, that the most natural conception is that of a dark chip or scale thrown up from beneath, like scum in a caldron, and floating, partly submerged, in the blazing flames of the photosphere which overhang its edges, and bridge across it, and cover it with filmy veils, until at last it settles down again and disappears. It hardly *looks* like a mere hollow filled with cooler vapor, nor is its appearance that of a cyclone seen from above. But then, on the other hand, its spectrum under high dispersion is very peculiar; not at all that of a solid, heated slag, but it is made up of countless fine dark lines, packed almost in contact, showing, however, here and there, a bright line, or at least an interspace where the rank is broken by an interval wider than that which elsewhere separates the elementary lines,—a spectrum, which, so far as I know, has not yet found an analogue in any laboratory experiment. It seems, however, to belong to the type of absorption spectra, and to indicate, as the accepted theory requires, that the spot is dark in consequence of *loss* of light, and not from any original defect of luminosity. Here, certainly, are problems that require solution.

The problem of the sun's peculiar rotation and

acceleration is a most important one solved. Probably its solution depends y upon a correct understanding of the f matter going on between the inte- surface of the fluid, cooling globe. It nt fact (already alluded to), that a similar ears to hold upon the disk of Jupiter; the near the equator of the planet complet- tation about five minutes more quickly at red spot which was forty degrees from . It is hardly necessary to say that an watching our terrestrial clouds from some tion (on the moon, for instance), would the reverse. Equatorial clouds would eir revolution more slowly than those in tude. *Our* storms travel toward the east, lcanic dust from Krakatoa moved swiftly may at least conjecture that the differ- n different planets somehow turns upon , whether the body whose atmospheric observe is receiving more heat from n it is throwing off itself. Whatever true explanation of this peculiarity in the un-spots, it will, when reached, probably t the solution of many other mysteries, trate conclusively between rival hypothe-

dicity of the sun-spots suggests a number t and interesting problems; relating, on d, to its mysterious cause, and, on the possible effects of this periodicity upon d its inhabitants. I am no 'sun-spottist' I am more than sceptical whether the influence of sun-spots amounts to any speaking of, except in the direction of But all must concede that this is by et demonstrated (it is not easy to prove); and there certainly are facts and ns enough tending the other way to re extended investigation of the subject. gation is embarrassed by the circumstance, by Dr. Gould, that the effects of sun-spot if they exist at all (as he maintains they ly to be quite different in different por- earth. The influence of changes in the the solar radiation will, he says, be first felt in alterations and deflections of the winds, thus varying the *distribution* of in upon the surface of the earth without much changing its absolute amount. In s it may, therefore, be warmer and dryer un-spot maximum, while in adjoining is the reverse.

be no question, that it is now one of the tant and pressing problems of observa- nomy to devise apparatus and methods ough to enable the student to follow d accurately the presumable changes in ven the hourly, amounts of the solar radi- night, perhaps, be possible with existing to obtain results of extreme value from kept up with persistence and scrupulous veral years at the top of some rainless mountain, if such can be found; but the undertaking would be a difficult and serious affair, quite beyond any private means.

Related to this subject is the problem of the connection between the activity of the solar surface and magnetic disturbances on the earth, — a connection unquestionable as matter of fact, but at present unexplained as matter of theory. It may have something to do with the remarkable prominence of iron in the list of solar materials; or the explanation may, perhaps, be found in the mechanism by means of which the radiations of light and heat traverse interplanetary space, presenting itself ultimately as a corollary of the perfected electro-magnetic theory of light.

The chromosphere and prominences present several problems of interest. One of the most fruitful of them relates to the spectroscopic phenomena at the base of the chromosphere, and especially to the strange differences in the behavior of different spectrum-lines, which, according to terrestrial observations, are due to the same material. Of two lines (of iron, for instance) side by side in the spectrum, one will glow and blaze, while the other will sulk in imperturbable darkness; one will be distorted and shattered, presumably by the swift motion of the iron vapor to which it is due, while the other stands stiff and straight.

Evidently there is some deep-lying cause for such differences; and as yet no satisfactory explanation appears to me to have been reached, though much ingenious speculation has been expended upon it. Mr. Lockyer's bold and fertile hypothesis, already alluded to, that at solar and stellar temperatures our elements are decomposed into others more elemental yet, seems to have failed of demonstration thus far, and rather to have lost ground of late; and yet one is almost tempted to say, 'It *ought* to be true,' and to add that there is more than a possibility that its essential truth will be established some time in the future.

Probably all that can be safely said at present is, that the spectrum of a metallic vapor (iron, for instance, as before) depends not only upon the chemical element concerned, but also upon its physical conditions; so that, at different levels in the solar atmosphere, the spectrum of the iron will differ greatly as regards the relative conspicuousness of different lines; and so it will happen, that, whenever any mass of iron vapor is suffering disturbance, those lines only which particularly characterize the spectrum of iron in that special state will be distorted or reversed, while all their sisters will remain serene.

The problem of the solar corona is at present receiving much attention. The most recent investigations respecting it — those of Dr. Huggins and Professor Hastings — tend in directions which appear to be diametrically opposite. Dr. Huggins considers that he has succeeded in photographing the corona in full sunshine, and so in establishing its objective reality as an immense solar appendage, sub-permanent in form, and rotating with the globe to which it is attached. One may call it 'an atmosphere,' if the

word is not to be too rigidly interpreted. I am bound to say that plates which he has obtained do really show just such appearances as would be produced by such a solar appendage, though they are very faint and ghost-like. I may add further, that, from a letter from Dr. Huggins, recently received, I learn that he has been prevented from obtaining any similar plates in England this summer by the atmospheric haze, but that Dr. Woods, who has been provided with a similar apparatus, and sent to the Riffelberg in Switzerland, writes that he has 'an assured success.'

Our American astronomer, on the other hand, at the last eclipse (in the Pacific Ocean), observed certain phenomena which seem to confirm a theory he had formulated some time ago, and to indicate that the lovely apparition is an apparition only, a purely optical effect due to the *diffraction* (not refraction, nor reflection either) of light at the edge of the moon — no more a solar appendage than a rainbow or a mock sun. There are mathematical considerations connected with the theory which may prove decisive when the paper of its ingenious and able proposer comes to be published in full. In the mean time it must be frankly conceded that the observations made by him are very awkward to explain on any other hypothesis.

Whatever may be the result, the investigation of the status and possible extent of a nebulous envelope around a sun or a star is unquestionably a problem of very great interest and importance. We shall be compelled, I believe, as in the case of comets, to recognize other forces than gravity, heat, and ordinary gaseous elasticity, as concerned in the phenomena. As regards the actual existence of an extensive gaseous envelope around the sun, I may add that other appearances than those seen at an eclipse seem to demonstrate it beyond question, — phenomena such as the original formation of clouds of incandescent hydrogen at high elevations, and the forms and motions of the loftiest prominences.

But of all solar problems, the one which excites the deepest and most general interest is that relating to the solar heat, its maintenance and its duration. For my own part, I find no fault with the solution proposed by Helmholtz, who accounts for it mainly by the slow contraction of the solar sphere. The only objection of much force is, that it apparently limits the past duration of the solar system to a period not much exceeding some twenty millions of years; and many of our geological friends protest against so scanty an allowance. The same theory would give us, perhaps, half as much time for our remaining lifetime; but this is no objection, since I perceive no reason to doubt the final cessation of the sun's activity, and the consequent death of the system. But while this hypothesis seems fairly to meet the requirements of the case, and to be a necessary consequence of the best knowledge we can obtain as to the genesis of our system and the constitution of the sun itself, it must, of course, be conceded that it does not yet admit of any observational verification. No measurements within our power can test it, so far as we can see at present.

It may be admitted, too, that much can be said in favor of other theories; such as the one which attributes the solar heat to the impact of meteoric matter, and that other most interesting and ingenious theory of the late Sir William Siemens.

As regards the former, however, I see no escape from the conclusion, that, if it were exclusively true, the earth ought to be receiving, as was pointed out by the late Professor Peirce, as much heat from meteors as from the sun. This would require the fall of a quantity of meteoric matter, — more than sixty million times as much as the best estimates make our present supply, and such as could not escape the most casual observation, since it would amount to more than a hundred and fifty[1] tons a day on every square mile.

As regards the theory of Siemens, the matter has been, of late, so thoroughly discussed, that we probably need spend no time upon it here. To say nothing as to the difficulties connected with the establishment of such a far-reaching vortex as it demands, nor of the fact that the temperature of the sun's surface appears to be above that of the dissociation point of carbon compounds, and hence above the highest heat of their combustion, it seems certainly demonstrated, that matter of the necessary density could not exist in interplanetary space without seriously affecting the planetary motions by its gravitating action as well as by its direct resistance; nor could the stellar radiations reach us, as they do, through a medium capable of taking up and utilizing the rays of the sun in the way this theory supposes.

And yet I imagine that there is a very general sympathy with the feeling that led to the proposal of the theory, — an uncomfortable dissatisfaction with received theories, because they admit that the greater part of the sun's radiant energy is, speaking from a scientific point of view, simply wasted. Nothing like a millionth part of the sky, as seen from the sun, is occupied, so far as we can make out, by objects upon which its rays can fall: the rest is vacancy. If the sun sends out rays in all directions alike, not one of them in a million finds a target, or accomplishes any useful work, unless there is in space some medium to utilize the rays, or unknown worlds of which we have no cognizance beyond the stars.

Now, for my own part, I am very little troubled by accusations of wastefulness against nature, or by demands for theories which will show what the human mind can recognize as 'use' for all energy expended. Where I can perceive such use, I recognize it with reverence and gratitude, I hope; but the

[1] In an article on astronomical collisions, published in the *North-American review* about a year ago, I wrongly stated the amount at fifty tons There was some fatality connected with my calculations for that article. I gave the amount of heat due to the five hundred tons of meteoric matter which is supposed to fall daily on the earth with an average velocity of fifteen miles per second as fifty-three calories annually per square metre, — a quantity two thousand times too great. Probably the error would have been noticed if even the number given had not been so small, compared with the solar heat, as fully to justify my argument, which is only strengthened by the correction. I owe the correction to Professor LeConte of California, who called my attention to the errors.

failure to recognize it in other cases creates in my mind no presumption against the wisdom of nature, or against the correctness of an hypothesis otherwise satisfactory. It merely suggests human limitations and ignorance. How can one without sight understand what a telescope is good for?

At the same time, perhaps we assume with a little too much confidence, that, in free space, radiation does take place equally in all directions. Of course, if the received views as to the nature and conduct of the hypothetical 'ether' are correct, there is no possibility of questioning the assumption; but, as Sir John Herschel and others have pointed out, the properties which must be ascribed to this 'ether,' to fit it for its various functions, are so surprising and almost inconceivable, that one may be pardoned for some reserve in accepting it as a finality. At any rate, as a fact, the question is continually started (the idea has been brought out repeatedly, in some cases by men of real and recognized scientific and philosophic attainment), whether the constitution of things may not be such that radiation and transfer of energy can take place only between ponderable masses; and that, too, without the expenditure of energy upon the transmitting-agent (if such exist) along the line of transmission, even *in transitu*. If this were the case, then, the sun would send out its energy only to planets and meteors and sister-stars, wasting none in empty space; and so its loss of heat would be enormously diminished, and the time-scale of the life of the planetary system would be correspondingly extended. So far as I know, no one has ever yet been able to indicate any kind of medium or mechanism by which vibrations, such as we know to constitute the radiant energy of light and heat, can be transmitted at all from sun to planet under such restrictions. Still one ought not to be too positive in assertions as to the real condition and occupancy of so-called vacant space. The 'ether' is a good working hypothesis, but hardly more as yet.

I need not add, that a most interesting and as yet inaccessible problem, connected with the preceding, is that of the mechanism of gravitation, and, indeed, of all forces that seem to act at a distance: as for that matter, in the last analysis, *all* forces do. If there really be an 'ether,' then it would seem that somehow all attractions and repulsions of ponderable matter must be due to its action. Challis's investigations and conclusions as to the effect of hydrodynamic actions in such a medium do not seem to have commanded general acceptance; and the field still lies open for one who will show how gravitation and other forces can be correlated with each other through the ether.

Meteors and the comets, seeming to belong neither to the solar system nor to the stellar universe, present a crowd of problems as difficult as they are interesting. Much has undoubtedly been gained during the last few decades, but in some respects that which has been learned has only deepened the mystery.

The problem of the origin of comets has been supposed to be solved to a certain extent by the researches of Schiaparelli, Heis, Professor Newton, and others, who consider them to be strangers coming in from outer space, sometimes 'captured' by planets, and forced into elliptic orbits, so as to become periodic in their motion. Certainly this theory has strong supports and great authority, and probably it meets the conditions better than any other yet proposed. But the objections are really great, if not insuperable, — the fact that we have so few, if any, comets moving in hyperbolic orbits, as comets *met* by the sun would be expected to move; that there seems to be so little relation between the direction of the major axes of cometary orbits, and the direction of the solar motion in space; and especially the fact, pointed out and insisted upon by Mr. Proctor in a recent article, that the alteration of a comet's natural parabolic orbit to the observed elliptic one, by planetary action, implies a reduction of the comet's velocity greater than can be reasonably explained. If, for instance, Brorsen's comet (which has a mean distance from the sun a little more than three times that of the earth) was really once a parabolic comet, and was diverted into its present path by the attraction of Jupiter, as generally admitted, it must have had its velocity reduced from about eleven miles a second to five. Now, it is very difficult, if not out of the question, to imagine any possible configuration of the two bodies and their orbits which could result in so great a change. While I am by no means prepared to indorse as conclusive all the reasoning in the article referred to, and should be very far from ready to accept the author's alternative theory (that the periodic comets have been ejected from the planets, and so are not their captives, but their children), I still feel that the difficulty urged against the received theory is very real, and not to be evaded, though it may possibly be overcome by future research.

Still more problematical is the constitution of these strange objects of such enormous volume and inconceivable tenuity, self-luminous and transparent, yet reflecting light, the seat of forces and phenomena unparalleled in all our other experience. Hardly a topic relating to their appearance and behavior can be named which does not contain an unsolved problem. The varying intensity, polarization, and spectroscopic character of their light; the configurations of the nucleus and its surrounding nebulosity; and especially the phenomena of jets, envelopes, and tail, — all demand careful observation and thorough discussion.

I think it may be regarded as certain, that the explanation of these phenomena when finally reached, if that time ever comes, will carry with it, and be based upon, an enormous increase in our knowledge as to the condition, contents, and temperature of interplanetary space, and the behavior of matter when reduced to lowest terms of density and temperature.

Time forbids any adequate discussion of the numerous problems of stellar astronomy. Our work, in its very nature incessant and interminable, consists, of course, in the continual observation and cataloguing of the places of the stars, with ever-increasing precision. These star-places form the scaffold and framework of all other astronomical

investigations involving the motions of the heavenly bodies: they are the reference-points and bench-marks of the universe. Ultimately, too, the comparison of catalogues of different dates will reveal the paths and motions of all the members of the starry host, and bring out the great orbit of the sun and his attendant planets.

Meanwhile, micrometric observations are in order, upon the individual stars in different clusters, to ascertain the motions which occur in such a case; and the mathematician is called upon again to solve the problem of such movement.

Now, too, since the recent work of Gill and Elkin in South Africa, and of Struve, Hall, and others, elsewhere, upon stellar parallax, new hopes arise that we may soon come to some wider knowledge of the subject; that, instead of a dozen or so parallaxes of doubtful precision, we may get a hundred or more relating to stars of widely different brightness and motion, and so be enabled to reach some trustworthy generalizations as to the constitution and dimensions of the stellar universe, and the actual rates of stellar and solar motion in space.

Most interesting, also, are the studies now so vigorously prosecuted by Professor Pickering in this country, and many others elsewhere, upon the brightness of the stars, and the continual variations in this brightness. Since 1875, stellar photometry has become almost a new science.

Then, there are more than a myriad of double and multiple stars to watch, and their orbits to be determined; and the nebulae claim keen attention, since some of them appear to be changing in form and brightness, and are likely to reveal to us some wonderful secrets in the embryology of worlds.

Each star also presents a subject for spectroscopic study; for although, for the most part, the stars may be grouped into a very few classes from the spectroscopic point of view, yet, in detail, the spectra of objects belonging to the same group differ considerably and significantly, almost as much as human faces do.

For such investigations, new instruments are needed, of unexampled powers and accuracy, some for angular measurement, some for mere power of seeing. Photography comes continually more and more to the front; and the idea sometimes suggests itself, that by and by the human eye will hardly be trusted any longer for observations of precision, but will be superseded by an honest, unprejudiced, and unimaginative plate and camera. The time is not yet, however, most certainly. Indeed, it can never come at all, as relates to certain observations; since the human eye and mind together integrate, so to speak, the impressions of many separate and selected moments into one general view, while the camera can only give a brutal copy of an unselected state of things, with all its atmospheric and other imperfections.

New methods are also needed, I think (they are unquestionably possible), for freeing time-observations from the errors of personal equation; and increased precision is demanded, and is being progressively attained, in the prevention, or elimination, of instrumental errors, due to differences of temperature, to mechanical strains, and to inaccuracies of construction. Astronomers are now coming to the investigation of quantities so minute, that they would be completely masked by errors of observation that formerly were usual and tolerable. The science has reached a stage, where, as was indicated at the beginning of this address, it has to confront and deal with the possible unsteadiness of the earth's rotation, and the instability of its axis. The astronomer has now to reverse the old maxim of the courts: for him, and most emphatically at present, *de minimis curat lex*. Residuals and minute discrepancies are the seeds of future knowledge, and the very foundations of new laws.

And now, in closing this hurried and inadequate, but I fear rather tedious, review of the chief problems that are at present occupying the astronomer, what answer can we give to him who insists, *Cui bono?* and requires a reason for the enthusiasm that makes the votaries of our science so ardent and tireless in its pursuit? Evidently very few of the questions which have been presented have much to do directly with the material welfare of the human race. It may possibly turn out, perhaps, that the investigation of the solar radiation, and the behavior of sun-spots, may lead to some better understanding of terrestrial meteorology, and so aid agricultural operations and navigation. I do not say it will be so, — in fact, I hardly expect it, — but I am not sure it will not. Possibly, too, some few other astronomical investigations may facilitate the determination of latitudes and longitudes, and so help exploration and commerce: but, with a few exceptions, it must be admitted that modern astronomical investigations have not the slightest immediate commercial value.

Now, I am not one of those who despise a scientific truth or principle because it admits of an available application to the affairs of what is called 'practical life,' and so is worth something to the community in dollars and cents: its commercial value is — just what it is — to be accepted gratefully.

Indirectly, however, almost all scientific truth has real commercial value, because 'knowledge is power,' and because (I quote it not irreverently) 'the truth shall make you free,' — any truth, and to some extent; that is to say, the intelligent and intellectually cultivated will generally obtain a more comfortable livelihood, and do it more easily, than the stupid and the ignorant. Intelligence and brains are most powerful allies of strength and hands in the struggle for existence; and so, on purely economical grounds, all kinds of science are worthy of cultivation.

But I should be ashamed to rest on this lower ground: the highest value of scientific truth is not economic, but different and more noble; and, to a certain and great degree, its truest worth is more as an object of pursuit than of possession. The 'practical life' — the eating and the drinking, the clothing and the sheltering — comes *first*, of course, and is the necessary foundation of any thing higher; but it is not the whole or the best or the most of life. Apart from all spiritual and religious considerations, which lie one side of our relations in this association, there

can be no need, before this audience, to plead the higher rank of the intellectual, aesthetic, and moral life above the material, or to argue that the pabulum of the mind is worth as much as food for the body. Now, it is unquestionable, that, in the investigation and discovery of the secrets and mysteries of the heavens, the human intellect finds most invigorating exercise, and most nourishing and growth-making aliment. What other scientific facts and conceptions are more effective in producing a modest, sober, truthful, and ennobling estimate of man's just place in nature, both of his puny insignificance, regarded as a physical object, and his towering spirit, in some sense comprehending the universe itself, and so akin to the divine?

A nation oppressed by poverty, and near to starving, needs first, most certainly, the trades and occupations that will feed and clothe it. When bodily comfort has been achieved, then higher needs and wants appear; and then science, for truth's own sake, comes to be loved and honored along with poetry and art, leading men into a larger, higher, and nobler life.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

SOME DISTINCTIVE FEATURES OF THE BRITISH ASSOCIATION.

The general plan of organization of the British and American associations for the advancement of science is the same. The English body has a 'council' corresponding closely to our standing committee, and a 'general committee' corresponding to our body of fellows. There are, however, many points of difference which it is well worth while to study with a view of seeing what suggestions of value we may derive for our own guidance. The first of these is, that the British association has long since given up the practice of meeting and transacting business as an organized body. The general meetings are held only to hear such papers as the president's annual address, and not to transact business of any kind. The transaction of all business by the several committees saves much time which the American association spends in the work of organizing the meeting, and electing new members; and we may expect, that, as our numbers increase, this work will become so cumbrous that we shall finally adopt some plan of putting it entirely into the hands of committees.

The organization and conduct of the scientific proceedings are so like those adopted by ourselves as to call for little remark. The division into sections is substantially the same as with us; and the main difference between the sectional programmes is that no estimated length of a paper is given by our neighbors, thus avoiding one source of deception which frequently annoys intended listeners. Perhaps it was owing to the peculiar circumstances of the meeting, that the papers and discussions were of a quality superior to what we are wont to expect in a semi-popular assemblage. Only men who had some serious object could undertake so long a journey; and the result has been, that what such men have had to say was heard without any admixture of the crude and ignorant speculations so often interjected into the discussions, and even forming the subject of the papers. The one subject in which English thought has always been pre-eminent is the theories of physics, and the discussion on the seat of electromotive forces was all the more creditable from the barrenness of the subject. This discussion well illustrated the comparative state of science in the two countries; which may be expressed by saying, that, while a few men of the highest genius stand on the same level, foreign countries are greatly superior to us in the number of trained men, thoroughly grounded in first principles, which they are able to bring forward. The lucid statement by Professor Willard Gibbs of New Haven, of the principles involved, was the feature of the discussion; yet it would have been hard for the speaker to collect in his own country so appreciative an audience as that which greeted him from beyond the ocean.

The most valuable work of the British association has been the reports and investigations undertaken by committees of its appointment. Occasionally these reports have comprised synopses of the progress of science in special branches made by individual members, and presented to the society. The greater number have, however, been accounts of special researches, the funds for prosecuting which have been supplied by the association. A splendid example of such work, which must ever redound to the credit of the body which undertook it, is the system of electrical units now universally adopted, the basis for which was furnished by a committee of the British association. It can hardly be too much to say, that no one work of recent times has done more for the progress and diffusion of electrical

science than this. The committees are generally continued from year to year, and thus form permanent working bodies, each pursuing a definite object. Naturally, nearly all the work will be done by one or a small number of members; but the latter have the advantage and stimulus of the co-operation and advice of their fellow members, who again are in a position to provide for the continuance of the work in case the person in charge gives it up. An idea of the present importance of this feature of the organization may be gained from the fact, that there are more than forty such committees at work, reporting annually. Some examples may be cited to show the character of the work undertaken: A committee on underground temperature collects determinations of the rate of increase of temperature in mines, and other places where it is possible to determine it; another is collecting and investigating meteoric dust; another investigates the lunar disturbance of gravity; Mr. Francis Galton is at the head of a committee devising a system of statistical measurements of human beings; the economists have a committee investigating the rate of wages, and its relation to economic progress. In a word, a range of subjects from tables of binary quantics to patent legislation, and the migration of birds, are being regularly investigated. We wish there could be a body of men in this country pursuing similar objects.

The number of Americans present at the meeting was even greater than could have been expected; and the high character of the American representation is sufficiently shown by the fact that six ex-presidents of the American association were in attendance.

STEPS TOWARDS A KINETIC THEORY OF MATTER.[1]

THE now well-known kinetic theory of gases is a step so important, in the way of explaining seemingly static properties of matter by motion, that it is scarcely possible to help anticipating, in idea, the arrival at a complete theory of matter, in which all its properties will be seen to be merely attributes of motion.

Rich as it is in practical results, the kinetic theory of gases, as hitherto developed, stops absolutely short at the atom or molecule, and gives not even a suggestion towards explaining the properties in virtue of which the atoms or molecules mutually influence one another.

[1] Address to the mathematical and physical section of the British association at Montreal, Aug. 28, 1884, by Professor Sir WILLIAM THOMSON, M.A., LL.D., D.C.L., F.R.S., L. & E., F.R.A.S., president of the section.

Every one who has hitherto written or done any thing very explicit in the kinetic theory of gases has taken the mutual action of molecules in collision as repulsive. May it not, after all, be attractive? Imagine a great multitude of particles enclosed by a boundary which may be pushed inwards in any part, all round, at pleasure. Now station an engineer corps of Maxwell's army of sorting demons all round the enclosure, with orders to push in the boundary diligently everywhere when none of the besieged troops are near, and to do nothing when any of them are seen approaching, and until after they have turned again inwards. The result will be, that, with exactly the same sum of kinetic and potential energies of the same enclosed multitude of particles, the throng has been caused to be denser. Now, Joule's and Thomson's old experiments on the efflux of air prove, that if the crowd be common air, or oxygen, or nitrogen, or carbonic acid, the temperature is a little higher in the denser than in the rarer condition when the energies are the same. By the hypothesis, equality of temperature between two different gases, or two portions of the same gas at different densities, means equality of kinetic energies in the same number of molecules of the two. From the observations proving the temperature to be higher, it therefore follows that the potential energy is smaller in the condensed crowd. This (always, however, under protest as to the temperature hypothesis) proves some degree of attraction among the molecules, but it does not prove ultimate attraction between two molecules in collision, or at distances much less than the average mutual distance of nearest neighbors in the multitude.

We must look distinctly on each molecule as being either a little elastic solid, or a configuration of motion in a continuous, all-pervading liquid. How we can ever permanently rest anywhere short of this last view is not evident; but it would be a very pleasant temporary resting-place on the way to it, if we could, as it were, make a mechanical model of a gas out of little pieces of round, perfectly elastic, solid matter, flying about through the space occupied by the gas, and colliding with one another, and against the sides of the containing vessel. But alas for a mechanical model consisting of the cloud of little elastic solids flying about amongst one another! Though each particle have absolutely perfect elasticity, the end must be pretty much the same as if it were but imperfectly elastic. The average effect of repeated and repeated mutual collisions must be to gradually convert all the translational energy into energy of shriller and shriller vibrations of the molecule. Even if this fatal fault in the theory did not exist, and if we could be perfectly satisfied with the kinetic theory of gases founded on the collisions of elastic solid molecules, there would still be beyond it a grander theory, which need not be considered a chimerical object of scientific ambition, — to explain the elasticity of solids.

If we could make out of matter devoid of elasticity a combined system of relatively moving parts, which in virtue of motion, has the essential characteristic

of an elastic body, this would be at least a finger-post, pointing a way which we may hope will lead to a kinetic theory of matter. Any ideal system of material particles, acting on one another mutually through mass-less connecting springs, may be perfectly imitated in a model consisting of rigid links jointed together, and having rapidly rotating fly-wheels pivoted on some or on all of the links. The drawings (figs. 1 and 2) illustrate two such material systems. The directions of rotation of the fly-wheels in the gyrostatic

FIG. 1.

FIG. 2.

system (fig. 2) are indicated by directional ellipses, which show in perspective the direction of rotation of the fly-wheel of each gyrostat. The gyrostatic system (fig. 2) might have been constituted of two gyrostatic members, but four are shown for symmetry. The enclosing circle represents in each case, in section, an enclosing spherical shell to prevent the interior from being seen. In the inside of one there are fly-wheels; in the inside of the other, a massless spring. The projecting hooked rods seem as if they are connected by a spring in each case. If we hang any one of the systems up by the hook on one of its projecting rods, and hang a weight to the hook of the other projecting rod, the weight, when first put on, will oscillate up and down, and will go on doing so forever, if the system be absolutely unfrictional. If we check the vibration by hand, the weight will hang down at rest, the pin drawn out to a certain degree; and the distance drawn out will be simply proportional to the weight hung on, as in an ordinary spring-balance.

Here, then, out of matter possessing rigidity, but absolutely devoid of elasticity, we have made a perfect model of a spring in the form of a spring-balance. Connect millions of millions of particles by pairs of rods such as these of this spring-balance, and we have a group of particles constituting an elastic solid.

The gyrostatic model spring-balance is arranged to have zero moment of momentum as a whole, and therefore to contribute nothing to the Faraday rotation. With this arrangement, the model illustrates the luminiferous ether in a field unaffected by magnetic force. But now let there be a different rotational velocity imparted to the jointed square, round the axis of the two projecting hooked rods, such as to give a resultant moment of momentum round any given line through the centre of inertia of the system, and let pairs of the hooked rods in the model thus altered, which is no longer a model of a mere spring-balance, be applied as connections between millions of pairs of particles, as before, with the lines of resultant moment of momentum all similarly directed: we now have a model elastic solid which will have the property that the direction of vibration in waves of rectilinear vibrations propagated through it shall turn round the line of propagation of the waves; just as Faraday's observation proves to be done by the line of vibration of light in a dense medium between the poles of a powerful magnet. The case of wave-front perpendicular to the lines of resultant moment of momentum (that is to say, the direction of propagation being parallel to these lines) corresponds, in our mechanical model, to the case of light travelling in the direction of the lines of force in a magnetic field.

But now, with the view of ultimately discarding the postulate of rigidity from all our materials, let us suppose some to be absolutely destitute of rigidity, and to possess merely inertia and incompressibility, and mutual impenetrability with reference to the still remaining rigid matter. With these postulates, we can produce a perfect model of mutual action at a distance between solid particles, fulfilling the condition, so keenly desired by Newton and Faraday, of being explained by continuous action through an intervening medium. Imagine a solid bored through with a hole, and placed in our ideal perfect liquid. For a moment let the hole be stopped by a diaphragm, and let an impulsive pressure be applied for an instant uniformly over the whole membrane, and then instantly let the membrane be dissolved into liquid. This action originates a motion of the liquid relatively to the solid, of a kind to which has been given the name of 'irrotational circulation,' which remains absolutely constant, however the solid be moved through the liquid. Thus at any time the actual motion of the liquid, at any point in the neighborhood of the solid, will be the resultant of the motion it would have in virtue of the circulation alone were the solid at rest, and the motion it would have in virtue of the motion of the solid itself had there been no circulation established through the aperture. It is interesting and important to remark, in passing, that the whole kinetic energy of the liquid is the sum of the kinetic energies which it would have in the two cases separately. Now, imagine the whole liquid to be enclosed in an infinitely large, rigid containing-vessel; and in the liquid, at an infinite distance from any part of the containing-vessel, let two perforated solids, with irrotational circulation through each, be placed at rest near one another. The resultant fluid motion due to the two circulations will give rise to fluid pressure on the two bodies, which, if unbalanced, will cause them to move.

It might be imagined that the action at a distance, thus provided for by fluid motion, could serve as a foundation for a theory of the equilibrium and the vibrations of elastic solids, and the transmission of waves like those of light through an extended quasi-elastic solid medium. But, unfortunately, the equilibrium is essentially unstable. If, however, we connect the perforated bodies, with circulation through

them in the hydrokinetic system, by jointed rigid connecting-links, we may arrange for configurations of stable equilibrium. Thus, without fly-wheels, but with fluid circulations through apertures, we may make a model spring-balance, or a model luminiferous ether, either without or with the rotational quality corresponding to that of the true luminiferous ether in the magnetic fluid: in short, do all by the perforated solids, with circulations through them, that we saw we could do by means of linked gyrostats. But something that we cannot do by linked gyrostats, we can do by the perforated bodies with fluid circulation: we can make a model gas. The mutual action at a distance, repulsive or attractive according to the mutual aspect of the two bodies when passing within collisional distance of one another, suffices to produce the change of direction of motion in collision, which essentially constitutes the foundation of the kinetic theory of gases.

There remains, however, as we have seen before, the difficulty of providing for the case of actual impacts between the solids.

Let us annul the solids, and leave the liquid performing irrotational circulation round vacancy, in the place of the solid cores which we have hitherto supposed; or let us annul the rigidity of the solid cores of the rings, and give them molecular rotation according to Helmholtz's theory of vortex motion. As to whether, however, when the vortex theory of gases is thoroughly worked out, it will or will not be found to fail in a manner analogous to the failure already pointed out in connection with the kinetic theory of gases composed of little elastic solid molecules, one cannot at present speak with certainty.

PROGRESS OF CHEMISTRY SINCE 1848.[1]

With the death of Berzelius in 1848 ended a well-marked epoch in the history of chemistry: with that of Dumas — and, alas! that of Wurtz also — in 1884 closes a second.

The differences between what may properly be termed the 'Berzelian era,' and that with which the name of Dumas will forever be associated, show themselves in many ways, but in none more markedly than by the distinct views entertained as to the nature of a chemical compound.

According to the older notions, the properties of compounds are essentially governed by the qualitative nature of their constituent atoms, which were supposed to be so arranged as to form a binary system. Under the new ideas, on the other hand, it is mainly the number and arrangement of the atoms within the molecule which regulate the characteristics of the compound, which is to be looked on, not as built up of two constituent groups of atoms, but as forming one group. Another striking difference of view between the chemistry of the Berzelian era and that of what we sometimes term the 'modern epoch,' is illustrated by the so-called 'substitution theory.' Dumas, to whom we owe this theory, showed that chlorine can take the place of hydrogen in many compounds, and that the resulting body possesses characters similar to the original. But there is another change of view, dating from the commencement of the Dumas epoch, which has exerted an influence, equal, if not superior, to those already named on the progress of chemistry, and that is, as to the use of equivalent or molecular weights.

The theory of organic radicals, developed by Liebig so long ago as 1834, received numerous experimental confirmations in succeeding years. Bunsen's classical research on cacodyl, proving the possibility of the existence of metallo-organic radicals capable of playing the part of a metal, and the isolation of the hydrocarbon ethyl by Frankland in 1849, laid what the supporters of the theory deemed the final stone in the structure.

The fusion of the radical and type theories, chiefly effected by the discovery in 1849 of the compound ammonias by Wurtz, brings us to the dawn of modern chemistry. Henceforward organic compounds were seen to be capable of comparison with simple inorganic bodies, and hydrogen capable of replacement not only by chlorine or by a metal, but by an organic group or radical.

At the Edinburgh meeting of this association in 1850, Williamson read a paper on 'Results of a research on aetherification,' which not only included a satisfactory solution of an interesting and hitherto unexplained problem, but was destined to exert a most important influence on the development of our theoretical views: for he proved, contrary to the then prevailing ideas, that ether contains twice as much carbon as alcohol, and that it is not formed from the latter by a mere separation of the elements of water, but by an exchange of hydrogen for ethyl; and this fact, being in accordance with Avogadro's law of molecular volumes, could only be represented by regarding the molecule of water as containing two atoms of hydrogen to one of oxygen, one of the former being replaced by one of ethyl to form alcohol, and the two of hydrogen by two of ethyl to form ether. Then Williamson introduced the type of water (subsequently adopted by Gerhardt) into organic chemistry, and extended our views of the analogies between alcohols and acids by pointing out that these latter are also referable to the water-type, predicting that bodies bearing the same relations to the ordinary acids as the ethers do to the alcohols must exist, — a prediction shortly afterwards (1852) verified by Gerhardt's discovery of the anhydrides.

Again, in 1852, we note the first germs of a theory which was destined to play an all-important part in the progress of the science; viz., the doctrine of valency, or atomicity; and to Frankland it is that we owe this new departure. But whether we range ourselves with Kekulé, who supports the unalterable character of the valency of each element, or with Frankland, who insists on its variability, it is now clear to most

[1] Abstract of an address to the chemical section of the British association at Montreal, Aug. 28, 1884, by Professor Henry Enfield Roscoe, Ph.D., LL.D., F.R.S., F.C.S., president of the section.

chemists that the hard and fast lines upon which this theory was supposed to stand cannot be held to be secure.

But however many doubts may have been raised, in special instances, against a thorough application of the law of valency, it cannot be denied that the general relations of the elements which this question of valency has been the means of bringing to light are of the highest importance, and point to the existence of laws of nature of the widest significance; as seen in the periodic law of the elements first foreshadowed by Newlands, but fully developed by Mendelejeff and Lothar Meyer. But this periodic law makes it possible for us to do more: for as the astronomer, by the perturbations of known planets, can predict the existence of hitherto unknown ones, so the chemist, though of course with much less reliable means, has been able to predict with precision the properties, physical and chemical, of certain missing links amongst the elements; such as ekaluminium and ekaboron, then unborn, but which shortly afterwards became well known to us in the flesh as gallium and scandium.

Arising out of Kekulé's theory of the tetrad nature of the carbon atom, came the questions which have caused much debate among chemists: 1°. Are the four combining units of the carbon atom of equal value, or not? and 2°. Is the assumption of a dyad carbon atom, in the so-called non-saturated compounds, justifiable, or not? The answer to the first of these, a favorite view of Kolbe's, is given in the now well-ascertained laws of isomerism; and from the year 1862, when Schorlemmer proved the identity of the hydrides of the alcohol radicals with the so-called radicals themselves, this question may be said to be set at rest.

Passing from this subject, we arrive, by a process of natural selection, at more complicated cases of chemical orientation; that is, given certain compounds which possess the same composition and molecular formulae but varying properties, to find the difference in molecular structure by which such variation of properties is determined. Problems of this nature can now be satisfactorily solved, the number of possible isomers foretold, and this prediction confirmed by experiment.

The discovery of the aniline colors by Perkin, their elaboration by Hofmann; the synthesis of alizarin by Graebe and Liebermann, being the first vegetable coloring-matter which has been artificially obtained; the artificial production of indigo by Baeyer; and, lastly, the preparation by Fischer of kairine, a febrifuge as potent as quinine, — are some of the well-known recent triumphs of modern synthetical chemistry.

In no department of chemistry has the progress made been more important than in that concerned with the accurate determination of the numerical, physical, and chemical constants, upon the exactitude of which every quantitative chemical operation depends. Amongst the most interesting recent additions to our knowledge, made in this department, we may note the classical experiments, in 1880, of J. W. Mallet on aluminium, and, in the same year, of J. P. Cooke on antimony, and those, in the present year, of Thorpe on titanium.

In referring to the work in spectrum analysis, Professor Roscoe recalled some of the more remarkable conclusions to which the researches of Lockyer, Schuster, Liveing and Dewar, Wüllner, and others, in this direction, have led. In the first place, it is well to bear in mind that a difference of a very marked kind, first distinctly pointed out by Alex. Mitscherlich, is to be observed between the spectrum of an element and that of its compounds, the latter only being seen in cases in which the compound is not dissociated at temperatures necessary to give rise to a glowing gas; second, that these compound spectra (as, for instance, those of the halogen compounds of the alkaline-earth metals) exhibit a certain family likeness, and show signs of systematic variation in the position of the lines, corresponding to changes in the molecular weight of the vibrating system. Still, it cannot be said that as yet definite proof has been given in support of the theory that a causal connection is to be found between the emission spectra of the several elements belonging to allied groups and their atomic weights, or other chemical or physical properties. In certain of the single elements, however, the connection between the spectra and the molecular constitution can be traced. In the case of sulphur, for example, three distinct spectra are known. The first of these, a continuous one, is exhibited at temperatures below 500°, when, as we know from Dumas' experiments, the density of the vapor is three times the normal, showing that at this temperature the molecule consists of six atoms. The second spectrum is seen when the temperature is raised to above 1000°, when, as Deville and Troost have shown, the vapor reaches its normal density; and the molecule of sulphur, as with most other gases, contains two atoms; and this is a band-spectrum, or one characterized by channelled spaces. Together with this band-spectrum, and especially round the negative pole, a spectrum of bright lines is observed. This latter is doubtless due to the vibrations of the single atoms of the dissociated molecule, the existence of traces of a band-spectrum demonstrating the fact, that, in some parts of the discharge, the tension of dissociation is insufficient to prevent the reunion of the atoms to form the molecule.

The most remarkable results obtained by Abney and Festing show that the radical of an organic body is always represented by certain well-marked absorption-bands; differing, however, in position, according as it is linked with hydrogen, a halogen, or with carbon, oxygen, or nitrogen. Indeed, these experimenters go so far as to say that it is highly probable, that, by this delicate mode of analysis, the hypothetical position of any hydrogen which is replaced may be identified; thus pointing out a method of physical orientation, of which, if confirmed by other observers, chemists will not be slow to avail themselves.

One of the noteworthy features of chemical progress is the interest taken by physicists in fundamental

questions of the science, — Sir William Thomson's interesting speculations, founded upon physical phenomena, respecting the probable size of the atom; and Helmholtz's discussion of the relation of electricity and chemical energy; and the theory of the vortex-ring constitution of matter, thrown out by Sir William Thomson, and lately worked out, from a chemical point of view, by J. J. Thomson of Cambridge.

Another branch of chemistry which has recently attracted much experimental attention is that of thermo-chemistry, — a subject upon which, in the future, the foundation of dynamical chemistry must rest, and one which already proclaims the truth of the great principle of the conservation of energy, in all cases of chemical as well as of physical change. But here, although the materials hitherto collected are of very considerable amount and value, the time has not yet arrived for expressing these results in general terms; and we must therefore be content to note progress in special lines, and wait for the expansion into wider areas.

In conclusion, Professor Roscoe spoke of the part English chemists had played in the past, and of the marked difference between the data-gathering German work, and the systematizing of the facts known, which is going on in England. He also referred to what he considered the best method of educating chemists, — by giving them as sound and extensive a foundation in the theory and practice of chemical science as their time and abilities will allow, rather than forcing them prematurely into the preparation of a new series of homologous compounds, or the investigation of some special reaction, or of some possible new coloring-matter, though such work might doubtless lead to publication, — and called attention to the prominence of English industrial chemistry.

THE CORRELATION OF GEOLOGICAL FORMATIONS.[1]

THIS address was devoted to a consideration of a few remarkable exceptions to the rule that similarity of faunas and floras in fossiliferous formations throughout the surface of the world implies identity of geological age. Some interesting contributions have been made to this question by the geological survey of India, where Mr. Blanford's experience has been chiefly derived, and by the geologists of Australia and South Africa; and he first noticed a few typical instances, several of them Indian, in which the system of determining the age of various formations by the fauna or flora has led to contradictory results, and then showed where the source of error appears to lie. The famous Pikermi beds of Greece, a few miles east of Athens, contain a vertebrate fauna nearly always quoted as miocene; but they overlie strata with well-proved pliocene marine Mollusca. The Siwalik beds that flank the Himalaya north of Delhi are still classed as miocene by most European writers, but are regarded as pliocene by the Indian survey, on evidence found by tracing them west and south into Sind. The Gondwána system of central India, a great sequence of fresh-water beds probably of fluviatile origin, over 20,000 feet thick, is of unusual interest on account of the extraordinary conflict of paleontological evidence it presents to the observer. Its subdivisions are numerous, and vary in almost every place of occurrence. One (the Tálchir beds) contains rounded bowlders chiefly of metamorphic rocks up to six feet across, embedded in fine silt: others are characterized by an intermingling of floras and faunas that give rise to a mass of contradictions; beds with a Triassic fauna overlying. others with Rhaetic or Jurassic floras. The Australian coal-measures and their associated beds present even a more remarkable instance of homotaxial perversity, a Jurassic flora being of the same age as a carboniferous marine fauna. Some of these beds (Hawkesbury) again contain transported bowlders, which occur once more in the lower members (Ecca beds) of the Karoo formation of interior South Africa. The latter presents a striking likeness to the Gondwána system of India. In both countries, a thick fresh-water formation occupies a large area of the interior of the country, whilst on the coast some marine Jurassic and cretaceous rocks are found; and as in India, so in South Africa, the uppermost inland mesozoic fresh-water beds are capped by volcanic.

Other examples of discrepancies in paleontological evidence might be given, but he would add merely a mention of the single case known to him in which the discordant records are both marine, namely, Barrande's 'colonies' in Bohemia; but here the discordance is much less than in the cases before cited, and moreover Barrande's conclusion is disputed by other observers.

In most of the cases he had named, the conflict is between the evidence of marine and terrestrial organisms. Manifestly one or the other of these leads to erroneous conclusions; and in making choice between the two, most geologists accept evidence of the marine fossils. The reason is not far to seek. So far as he was aware, no case is known where such an anomaly as that displayed in the Gondwánas of India has been detected amongst marine formations of which the sequence was unquestioned. Further, if we compare the distribution of marine with that of terrestrial and fresh-water animals and plants at the present day, we shall find a very striking difference; and it is possible that this difference may afford a clew to the conditions that prevailed in past times.

Wanderers into what they fancy unexplored tracts in paleontology are likely to find Professor Huxley's footprints on the path they are following. In his paper on the Hyperodopedon, he says: "It does not appear to me that there is any necessary relation between the fauna of a given land and that of the seas on its shores. . . . What now happens geographically to provinces in space, is good evidence as to what, in former times, may have happened to provinces in time; and an essentially identical land-

[1] Abstract of an address to the geological section of the British association at Montreal, Aug. 28, 1884, by W. T. BLANFORD, F.R.S., Sec. 7, G.S., F.R.G.S., president of the section.

may have been contemporary with several ive marine faunae. At present our knowl- the terrestrial faunae of past epochs is so hat no practical difficulty arises from using, o, sea-reckoning for land time. But I think hly probable that sooner or later the inhabit- the land will be found to have a history of vn."

these words were written, more than twenty- ars ago, scarcely one of the geological details h Mr. Blanford called attention was known. I not point out how wonderful a commentary etails have afforded to Professor Huxley's But there is, he believed, an additional distinc- tween land and marine faunas, that requires At the present day the difference between l-faunas of different parts of the world is so reater than that between the marine faunas, both were found fossilized, whilst there would little difficulty in recognizing different marine s as of like age from their organic remains, ial and fresh-water beds would in all proba- e referred to widely differing epochs.

present knowledge of the distribution of ter- and marine faunas and floras can be only treated. Among mammals and reptiles, the forms are generally the most widely diffused. give better illustration: eighty families are y marine, and twenty-nine are confined to vater; of the first, fifty are universally, or universally, distributed; while of the second, e (Cyprinidae) is found in five of Wallace's , and not one is met with in all six. It is ble to conceive a greater contrast. The dis- n of land and sea Mollusca leads to a similar ion as to the relatively narrow range of the rms. Throughout the marine invertebrata, but eric types are restricted to particular seas: the y are found in suitable habitats over a large of the oceans. Indeed, the marine provinces ve been hitherto distinguished are founded on specific than on generic distinctions. offers a still more remarkable example: so n is the marine vegetation of the world, that rate regions can be established in the ocean, Drude makes fourteen on the land.

Blanford alluded to the evidence of the exist- land-regions in past times. Proofs are already ulated of differences between the fauna of dis- untries in tertiary times. The eocene, miocene, ocene Vertebrata of North America differ quite h from those of Europe as do the genera of the t day; and there was as much distinction be- the mammalia of the Himalayas and of Greece he Siwalik and Pikermi faunas were living as s now. The reptiles of the American Jurassic s present wide differences from those of the an beds of that age. But there is no reason posing that the limits or relations of the zoö- and botanical regions in past times were the s they now are. It is quite certain, indeed, e distribution of land-areas has undergone us variations, whether the great oceanic tract has remained unchanged in its general outlines or not; and the migration of the terrestrial fauna and flora must have been dependent upon the presence or absence of land communication between different continental tracts: in other words, the terrestrial regions of past epochs, although just as clearly marked as those of the present day, were very differently distributed.

The idea that marine and terrestrial faunas and floras were similar throughout the world's surface in past times, is so ingrained in paleontological science, that it will require many years yet before the fallacy of the assumption is generally admitted. No circumstance has contributed more widely to the belief than the supposed universal diffusion of the carboniferous flora. The evidence that the plants which prevailed in the coal-measures of Europe were replaced by totally different forms in Australia, despite the closest similarity in the marine inhabitants of the two areas at the period, will probably go far to give the death-blow to an hypothesis that rests upon no solid ground of observation. In a vast number of instances it has been assumed that similarity between fossil terrestrial faunas and floras proves identity of geological age; and by arguing in a vicious circle, the occurrence of similar types, assumed without sufficient proof to belong to the same geological period, has been alleged as evidence of the existence of similar forms in distant countries at the same time.

It may perhaps have surprised some, that Mr. Blanford scarcely alluded to any American formations, and especially that he had not mentioned so well-known and interesting a case of conflicting paleontological evidence as that of the Laramie group. His reason was simply, that there were probably many present who were personally acquainted with the geology of the American cretaceous and tertiary beds, and who were far better able to judge than he of the evidence as a whole. To all who are studying such questions in America, he thought it would be more useful to give the details of similar geological puzzles from the eastern hemisphere, than to attempt an imperfect analysis of difficult problems in the great western continent.

THE PHYSIOLOGY OF DEEP-SEA LIFE.[1]

THE physiology of the deep-sea life has, until lately, received but little attention from professed physiologists. No one has yet set forth the numerous difficulties which are encountered, when the attempt is made to comprehend the mode in which the ordinary physiological processes of Vertebrata and other animals are carried on under the peculiar physical conditions which exist at great depths.

A knowledge of the conditions under which gases occur in a state of absorption in the ocean-waters

[1] Abstract of an address to the biological section of the British association at Montreal, Aug. 28, 1884, by H. N. MOSELEY, Esq., M.A., F.R.S., Linacre professor of human and comparative anatomy in the University of Oxford, president of the section.

is of primary importance to the physiologist. It appears from the results of Professor Dittmar's researches into the composition of the ocean-water collected by the Challenger, that, contrary to what was before suspected, the presence of free carbonic acid in sea-water is an exception. Hence, with regard to Mr. Murray's interesting discovery, that, after certain depths are reached, pteropod shells are dissolved, and disappear from the sea-bottom, and at certain farther depths Globigerina shells suffer the same fate, Professor Dittmar holds that the solution is not due to the presence of free acid, but to the solvent action of the sea-water itself. Thus the amount of carbonic acid normally present throughout the ocean cannot be inimical to life; but there must be in the depths of the ocean numerous bodies of richly carbonated water.

French physiologists have lately commenced researches on some of the problems of deep-sea life. Experiments have been made by Mr. Regnard with a view of determining the effects of high pressures, corresponding with those of the deep sea, on various organisms. Yeast, after being exposed to a pressure of a thousand atmospheres, equal to a depth of about sixty-five hundred fathoms of sea-water, for an hour, was mixed with a solution of sugar. An hour elapsed before any signs of fermentation appeared; and a mixture of yeast and sugar solution did not ferment at all whilst under a pressure of six hundred atmospheres, equal to a depth of about thirty-nine hundred fathoms. Algae, seeds of phanerogamic plants, infusoria, and even Mollusca and leeches, were found to be thrown into a condition of sleep, or latency, by exposure to similar pressures, recovering from this condition after a shorter or longer period of return to normal conditions. A fish without a swimming-bladder, or one with the bladder emptied of air, may be submitted to a pressure of a hundred atmospheres, equivalent to a depth of six hundred and fifty fathoms, without injurious effect. At two hundred atmospheres, equivalent to a depth of thirteen hundred fathoms, it becomes torpid, but soon revives when the pressure is removed. At three hundred atmospheres, equivalent to a depth of about two thousand fathoms, the fish dies. These experiments are of the highest interest. The pressure made use of was obtained by means of water, in the absence of air other than that absorbed at the normal atmosphere pressure; and thus the physical conditions produced were closely similar to those actually existent in the deep sea. They are the first of their kind.

Professor Paul Bert's somewhat similar experiments related to a different question altogether; namely, the effect, on aquatic organisms, of water subjected to the pressure of compressed air. He found that young eels were rapidly killed when subjected to a pressure of only fifteen atmospheres, and could not survive one of even seven atmospheres for any considerable time. He pointed out the essential difference between the conditions produced in such experiments and those existing in the deep sea, where the charge of oxygen contained by the water has been taken up at the surface under a pressure of one atmosphere only.

A question of the utmost moment, and one that has received a good deal of attention, is that as to the source of food of the deep-sea animals. Certainly a large proportion of this food is derived from the life on the ocean-surface. The *débris* of pelagic animals sinks slowly downwards, forming on its passage a sparsely scattered supply of food for any animals possibly living at intermediate depths, but becoming concentrated, as it were, on the bottom. A large part of the food-supply is also derived from the *débris* of the coasts, either directly from the littoral zone, or by rivers and the action of the tides from terrestrial life. Deep-sea life appears to diminish in abundance as coasts are receded from. Unfortunately, our knowledge of pelagic vegetable life is very imperfect, and it is to be hoped that botanists may be led to take up the subject. It will then be possible to form a nearer estimate of the extent to which plants are capable of forming a sufficient ultimate food-source for the greater part of the pelagic fauna, and, through it, of deep-sea life. The question is of importance; because, if the deep sea derived its main supply from the coasts and land-surfaces in the early history of the habitation of the globe by animals, there can have existed scarcely any deep-sea fauna until the littoral and terrestrial faunas and floras had become well established. It seems certain that the food, as it reaches the deep sea, is mostly in the form of dead matter; and it may be that the long but slender backward-directed teeth of many deep sea fish, resembling those of snakes, are used rather as aids for swallowing whole other fishes which have fallen from above, dead, and thus making the best of an occasional opportunity of a meal, than for catching and killing living prey.

Many interesting results may be expected when the histology of animals from great depths comes to be worked out, and especially that of the special sense-organs. At present very little has been attempted in this direction; principally, no doubt, because deep-sea specimens are too precious to be used for the purpose. With regard to the all-important question of the nature of the light undoubtedly present in the deep sea, it is hardly possible to accept Professor Verrill's recent startling suggestion (*Science*, iv. 8), that sunlight penetrates to the greatest depths with perhaps an intensity at from two thousand to three thousand fathoms, equal to that of some of our partially moonlight nights. Such a conjecture is entirely at variance with the results of all experiments on the penetration of sea-water by sunlight, as yet made by physicists,— results which have prevented other naturalists from adopting this solution of the problem.

The progress of research confirms the conclusions, early formed, that it is impossible to determine any successive zones of depth in the deep-sea regions, characterized by the presence of special groups of animals. Some groups of animals appear to be characteristic of water of considerable depth; but representatives of them struggle up into much shallower regions. There are numerous genera, and even spe-

cies, which range even from the shore-region to great depths. These facts add seriously to the difficulties encountered in the attempt to determine approximately the depths at which geological deposits have been found. Dr. Theodore Fuchs has attempted to determine what geological strata should be considered as of deep-sea formation; but, as he defines the deep-sea fauna as commencing at a hundred fathoms, and extending downwards to all depths, his results have little value as indicating the depths of ancient seas, or the extent of upheaval or depression of their bottoms. Mr. John Murray has shown that the depths at which modern deep-sea deposits have been formed can be approximately ascertained by the examination of their microscopical composition, and the condition of preservation of the shells and spicules.

The most important question with regard to life in the ocean, at present insufficiently answered, is that as to the conditions with regard to life of the intermediate waters between the surface and the bottom. The greatest uncertainty and difference of opinion exist as to whether the intermediate waters are inhabited at all by animals, and, if they are inhabited, to what extent; and these intermediate waters constitute by far the greater part of the ocean. Great care should be exercised in drawing conclusions from the depths ascribed to animals in some of the memoirs in the official work on the Challenger expedition. In many instances it is quite possible that a particular specimen may have entered the net at any depth.

With regard to the constitution of the deep-sea fauna, one of its most remarkable features is the general absence from it of paleozoic forms, excepting so far as representatives of the Mollusca and Brachiopoda are concerned; and it is remarkable, that, amongst the deep-sea Mollusca, no representatives of the Nautilidae and Ammonitidae, so excessively abundant in ancient periods, occur, and that Lingula, the most ancient brachiopod, should occur in shallow water only. It might well have been expected, that, had the deep sea been fully colonized in the paleozoic period, a considerable series of representative forms of that age might have survived there, in the absence of most of the active physical agents of modification which characterize the coast-regions.

With regard to the origin of the deep-sea fauna, there can be little doubt that it has been derived almost entirely from the littoral fauna, which also must have preceded, and possibly given rise to, the entire terrestrial fauna; yet it is not improbable that we should look to the pelagic conditions of existence as those under which most of the earliest types of animal life were developed. Nearly all the present inhabitants of the littoral zone revert to the pelagic free-swimming form of existence in their early developmental stages. And these pelagic larval forms are in many cases so closely alike in essential structure, though springing from parents widely differentiated from one another in the adult form, that it is impossible to regard them as otherwise than ancestral. The various early pelagic free-swimming forms, represented now mostly only by larvae, gradually adapted themselves to coast-life, and underwent various modifications to enable them to withstand the beating of the surf on the shores, and the actual modifying alterations of the tides, which, together with other circumstances of coast-life, acted as strong impulses to their further development and differentiation. Some developed hard shells and skeletons as protections; others secured their position by boring in the rocks or mud; others assumed an attached condition, and thus resisted the wash of the waves.

It is because the ancestors of nearly all animals have passed through a littoral phase of existence, preceded mostly by a pelagic phase, that the investigations now being carried on, on the coasts in marine laboratories, throw floods of light on all the fundamental problems of zoölogy. From the littoral fauna a gradual migration must have taken place into the deep sea; but probably this did not occur till the littoral fauna was very fully established, and considerable pressure was brought to bear on it by the struggle for existence. Life, too, must have become abundant in the littoral zone before there could have been a sufficient food-supply in the deeper regions adjoining it. Not until the development of terrestrial vegetation and animal life can the supply have reached its present abundance. Such a condition was, however, certainly reached in the carboniferous period. From the general absence of representatives of paleozoic forms from the deep sea, it is just possible, that, if deep oceans existed in paleozoic periods, they may not have been colonized at all, and that active migration into deep waters commenced in the secondary period. Very possibly the discharges of carbonic acid from the interior of the earth, which Professor Dittmar believes may have been sufficient to account for the vast existing deposits of coal and limestone, may have been much more abundant over the deep-sea beds in the paleozoic period, than at present, and have rendered the deep waters more or less uninhabitable.

RECENT GEOGRAPHICAL DISCOVERY.[1]

After some introductory remarks referring to his previous visit to Canada, Gen. Lefroy alluded to the relations of geography to geology as instanced in the changes in the earth's surface within historical times by the operation of geological causes. A recent German writer, Dr. Hahn, has enumerated ninety-six more or less extensive tracts known to be rising or sinking. For example: Mr. R. A. Peacock has accumulated evidence that the Island of Jersey had no existence in Ptolemy's time, and Mr. A. Howarth has collected similar proofs with regard to the arctic regions; and every fresh discovery, notably those of the gallant and ill-fated DeLong and of Nordenskiöld, adds to the number. Professor Hull has reached the conclusion that the land between Suez and the

[1] Address to the geographical section of the British association at Montreal, Aug. 28, 1884, by Gen. Sir J. H. Lefroy, R.A., C.B., K.C.M.G., F.R.S., F.S.A., vice-president of the Royal geographical society, president of the section.

Bitter Lakes has risen since the exodus; and from the Indian survey it is 'almost certain' that the mean sea-level at Madras is a foot lower than it was sixty years ago. From the Chinese annals it is learned that the so-called Hot Lake (Myk-kul) of Turkestan was formed about a hundred and sixty years ago; and there seems no good reason to reject the Japanese legend that Fusiyama itself was thrown up in the third century before our era.

He then touched lightly on the progress made in our knowledge of the geography of the Dominion of Canada, which comprises within its limits the pole of vertical magnetic attraction, commonly called the magnetic pole, and the focus of greatest magnetic force, also often but incorrectly called a pole. The first of these, discovered by Ross in 1835, was revisited in May, 1847, by officers of the Franklin expedition, whose observations have perished, and was again reached, or very nearly, by McClintock in 1859, and by Schwatka in 1879. Neither of these explorers, however, was equipped for observation. The utmost interest attaches to the question whether the magnetic pole has shifted its position in fifty years; and, although far from rating the difficulty lightly, it is probably approachable overland, without the great cost of an arctic expedition. The second, which is in the neighborhood of Cat Lake, has never been visited, although Dr. R. Bell was within two hundred miles of it. These two objects, and the exploration of an almost unknown tract of some seventy thousand square miles, lying east of Athabasca River, were declared worthy of the scientific ambition and energy of the dominion. He alluded also to the extent and importance of Lake Misstassini, which has recently been discovered in no very remote part of the dominion, — a lake rivalling Lake Ontario, if not Lake Superior, in magnitude.

He then mentioned the report of Lieut. R. P. Rodgers, U. S. N., on the state of the canal-works at Panama so lately as Jan. 25 last, and read the official returns of the amount of excavation during the months of October, 1883-March, 1884, by which it appeared that the quantity excavated per month had greatly increased during that time, and shows that the limit has not been reached. The two great problems which await solution are, how to deal with the River Chagres, and how to manage a cutting nearly four hundred feet deep. The Chagres, which is subject to great fluctuations of volume, it is proposed to arrest by an enormous dike, 1,050 yards long at the bottom, 2,110 yards at the top, 110 yards thick at the base, and 147 feet in the greatest height; the overflow of the reservoir so constructed to be led away by two artificial channels, partly utilizing the old bed. The cutting, nearly five hundred feet wide at the top, it is proposed to attack by gangs working on twelve different levels at the same time, one each side of the summit, dividing the width at each level into five parallel sections. Thus there will be a hundred and twenty gangs at work together, and it is confidently hoped that the whole will be really finished in 1888.

He next turned to another quarter, and referred to the mission intrusted to Mr. Joseph Thomson last year, in East Africa, by the Royal geographical society. After an unsuccessful start from Zanzibar in March of last year, — in which, however, he reached Kilima-njaro, and ascended it about nine thousand feet, — he returned to the coast from Taveta, and started again in July, this time from Mombasa. We are not yet fully acquainted with his route; but we know that he again reached the great mountain reputed to have an elevation of more than twenty thousand feet; that thence he reached the east side of Lake Nyanza; that he is the first who has stood on the shores of Lake M'Baringo; that thence, always among natives who had never before seen a white man, he reached Mount Kenia, reputed to be eighteen thousand feet high, and found his way back to the coast without any conflict or loss of life by violence; and this after a journey of about five hundred miles, nearly the whole of it through a country previously unknown to geography. Before Mr. Thomson's return to Zanzibar, Mr. H. H. Johnston, under direction of a committee of this association, whose plans are devoted primarily to the investigation of the fauna and flora of Kilima-njaro, had left Zanzibar in good health, and with every hope of ultimate success.

The president then alluded to the unfortunate French expedition of Col. Flatters, who, together with several other officers and men, was killed by the Touaregs in February, 1881. The French travellers have emphasized the probable consequences of the rapid progress of the religion of Mohammed among the African races of the northern equatorial zone, which in time may reach the populous basin of the Kongo, and may greatly affect the white settlements and missionary enterprises in Central Africa hereafter.

The Upper Kongo, from Stanley Falls to Stanley Pool, is now pretty well known; but as to its tributaries, much remains to be learned. Mr. Stanley has discovered two new lakes. The labors of that energetic traveller, Mr. de Brazza, have to a great extent cleared up the geography of the region included between the Kongo and the Ogowé, from the equator southwards; and there are now said to be twenty-two trading-stations in this part of the country. We are not informed what commerce exists. Higher up, but still to the north, Mr. Stanley has ascended the Aruwimi about a hundred miles, without having solved a question of no little interest; namely, whether it is identical with the Wellé, and takes its rise in the same watershed which feeds the White Nile, or whether we have not, beyond its sources, a drainage system, as yet untraced, but which may connect together a number of rivers whose relations to one another, and whose final outlet, are alike unknown. Lupton Bey reported, nearly two years ago, that a very large lake had been visited by one of his native subordinates west of the Aruwimi; and it is, in his opinion, probable that the Wellé flows into it. The southern basin of the Kongo has been crossed from Koando to Nyangivé by the late Dr. Pogge and Lieut. Wissman, the latter of whom continued his journey by Yabora to Zanzibar. He brings confirmation of the often re-

ported existence of a dwarfish race on the upper waters of the Sankuru.

Proceeding southward to the region of Portuguese exploration, Messrs. Britto, Capello, and Ivens, who reached the Upper Quango in 1878, returned last January to Loando, with the intention, it is said, of descending one of its great tributaries. They are now on the Kumene. Dr. Pogge compares the climate of Mussumba on the 8th parallel, in the month of December, to that of North Germany; and the fact illustrates, what we learn from so many other quarters, that much of the interior of Africa belongs, by reason of its elevation above the sea, to a far more temperate zone, and is better suited to the European constitution, than its geographical position promises. The terrible prevalence of fever, which has cost so many lives, will probably be mitigated in time, and by improved accommodation. The hills are comparatively free from it. The progress already made in the white occupation of Central Africa was well shown by a table of actual centres of trade, or missionary institutions (a hundred and twenty in number), now established there.[1]

He then took up the Russian project for diverting the Oxus, or Amu Darya, from the Sea of Aral to the Caspian; the level of which, according to Mr. George Kennan, a recent American traveller, is steadily but slowly falling, notwithstanding the enormous quantity of water poured in by the Volga, the Ural, and other rivers. In fact, Col. Vinukof says, that the Caspian is drying up fast, and that the fresh-water seals, which form so curious a feature of its fauna, are fast diminishing in number. At first view, there would not appear great difficulty in restoring water communication, the point where the river would be diverted being about two hundred and sixteen feet above the Caspian; but accurate levelling has shown considerable depressions in the intervening tract. Certainly the Oxus, or a branch of it, once flowed into the Caspian Sea. Prof. R. Lentz, of the Russian Académie impériale des sciences, sums up his investigation of ancient authorities by affirming that there is no satisfactory evidence of its ever having done so before the year 1320. Passages which have been quoted from Arab writers of the ninth century, only prove, in his opinion, that they did not discriminate between the Caspian Sea and the Sea of Aral. There is evidence that in the thirteenth and fourteenth centuries the river bifurcated, and one branch found its way to the Caspian, but probably ceased to do so in the sixteenth century. This agrees with Turkoman traditions. We may safely conclude that the thing will not be done; nor is it at all probable that Russian finances will permit the alternative proposal of cutting a purely artificial canal by the shortest line, at an estimated expense of from fifteen to twenty million roubles.

One of the finest feats of mountaineering on record was performed last year by Mr. W. W. Graham, who reached an elevation of twenty-three thousand five hundred feet in the Himalayas about twenty-nine hundred feet above the summit of Chimborazo, whose ascent by Mr. Whymper, in 1880, marked an epoch in these exploits. Mr. Graham was accompanied by an officer of the Swiss army, an experienced mountaineer, and by a professional Swiss guide. They ascended Kabru, a mountain visible from Darjeeling, lying to the west of Kanchinjunga, whose summit still defies the strength of man.

The primary triangulation of India, commenced in the year 1800, is practically complete. Much secondary triangulation remains to be executed, but chiefly outside the limits of India proper. The Pisgah views, by which some of the loftiest mountains in the world have been fixed in position, sometimes from points in the nearest Himalayas, a hundred and twenty miles distant, only serve to arouse a warmer desire for unrestrained access. The belief, long entertained, that a summit loftier than Mount Everest exists in Thibet, is by no means extinct; but it is possible that the snowy peak intended may prove eventually to be the Mount Everest itself of the original survey.

The Upper Oxus has now been traced from its sources in the Panjab, chiefly by native explorers; and to them we may be said to be indebted for all we know of Nepaul, from which Europeans are as jealously excluded as they are from the wildest central Asian kanate, although Nepaul is not so far from Calcutta as Kingston is from Quebec.

The Australian continent has been crossed again from east to west by Mr. Mills, who started with thirty camels attended by five Afghan drivers. Six of them died from the effects, as was supposed, of eating poisonous herbage. Mr. Mills did not deviate much from the tracks of the late Mr. W. C. Gosse and of Mr. J. Forrest: his journey has therefore added little to previous geographical knowledge; but it has helped to make the route better known, and afforded fresh evidence that the value of the camel in those terrible Australian saharas is in no degree less than it is where he has long been known as the 'ship of the desert.' Another traveller, Mr. C. Winnecke, starting from the Cowarie station on the Warburton River, in 28° south, has traversed about four hundred miles of new country in a northerly direction, and made a sketch-map of forty thousand square miles, up to Goyders Pillars, — a remarkable natural feature in the Tarleton Range. He, too, owed his success to the employment of camels. The international circumpolar expeditions have added, perhaps, to local knowledge, especially as regards the climate and means of supporting life at various stations, but not much, so far as reported, to geography generally. To this remark, however, a brilliant exception must be made. The disti
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by man, has been won by the late Lieut
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[1] A list of these is given in an appendix to the address, with their geographical positions collated with great care.

rewards the painful sufferings and losses of the party. Lieut. P. H. Ray, U.S.A., has also rectified many details of the map about Point Barrow, and discovered a range of hills, which he has named the Meade Mountains, running east from Cape Lisburne, from which at least two streams, unmarked, flow into the Polar Sea. We may expect similar service from the Italian parties at Patagonia, and from the Germans in South Georgia. Since the voyage of the Challenger, no marine researches have been more fruitful of results than those of the Talisman and the Dacia. The first was employed last year by the French government, to examine the Atlantic coasts from Rochefort to Senegal, and to investigate the hydrography and natural history of the Cape Verde, Canary, and Azores archipelagoes. The other ship, with her companion the International, was a private adventure, with the commercial purpose of ascertaining the best line for a submarine telegraph from Spain to the Canaries. These last two made some five hundred and fifty soundings, and discovered three shoals, one of them with less than fifty fathoms of water over it, between the continent of Africa and the islands. If we draw a circle passing through Cape Mogador, Teneriffe, and Funchal, its centre will mark very nearly this submarine elevation: the other two lie to the north of it. The Talisman found in mid-ocean but sixteen hundred and forty fathoms, among soundings previously set down as over two thousand fathoms.

Gen. Lefroy then spoke of the extension of railways in Mexico, South America, Africa, and Asia, and of the agreement to refer local time on this continent to a succession of first meridians, one hour apart. The next step will not be long delayed: that is, the agreement of the civilized world to use one first meridian; Paris, Ferrol, Washington, Rio de Janeiro, gracefully, as we venture to hope, giving that precedency to Greenwich, which is demanded by the fact that an overwhelming proportion of the existing nautical charts of all nations, and of maps and atlases in most of them, already refer their longitudes to that meridian. No other change would be so easy, or so little felt.

THE GENERAL STATISTICS OF THE BRITISH EMPIRE.[1]

WE will group our statistics under the following headings: 1°. The area consisting of widely extended regions; 2°. The inhabitants of these many lands; 3°. The works of man as they are displayed in this vast theatre of action.

old first, then, the area of the British Empire may be at the top at more than eight and a half millions of on twelve d?s. Out of this total, there are only a hun- side of the sunty thousand square miles in the United into five parallere are a million and a half of square hundred and tw

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ished in 1888.

He next turned

[1] address to the economic science and statis- ritish association at Montreal, Aug. 28, 1884, IPLE, Bart., G.C.S.I., C.I.E., D.C.L., LL.D., of the section.

miles in India; and the remainder, or seven millions, belong to the colonies and to the scattered possessions.

But there are other regions which have fallen, or are falling, under its political control more or less, such as Egypt, including a part of the Egyptian Sudan, some districts in southern Arabia, a part of Borneo, Zululand, the Transvaal, Afghanistan, and Beluchistan. Thus the total area, directly or indirectly, under the authority of the British empire, may be taken at nearly ten millions of square miles, or about one-fifth of the fifty millions of square miles composing the habitable globe.

As might be expected in an empire whereof the real basis of power is maritime, the coast-line is of an extraordinary length, to be measured by about 28,500 miles, with forty-eight large harbors. For the whole of this length, marine surveys have been prepared. But greatness does not depend on area alone, and there is a vast range in the scale of value for lands. Out of the ten millions of square miles, hardly one-fifth is cultivated or occupied, in the widest use of the term 'occupation.' In India, which is popularly, though not quite correctly, supposed to be thickly populated, the cultivable waste is not less than a quarter of a million of square miles.

In the second place, respecting the inhabitants, the total population amounts to 305,000,000 of souls in those regions which are included directly in the empire. This mass of humanity is composed of many diverse nationalities, a cardinal distinction between which is that of religion. Christianity, the religion of the dominant race, is professed by one-seventh of the whole. The religion which includes the largest number is Hinduism. There are 188,-000,000 of Hindus; and it may, indeed, be said that the whole Hindu race is subject to the British crown. The Hindus, then, form more than a half of the total population in the empire. The number of Buddhists is not considerable, amounting to about 7,000,000. The imperial area is, on the whole, but sparsely populated, with an average of only thirty-three persons to the square mile, notwithstanding the mighty aggregate of the people, as the population is most unequally distributed.

The third and last heading relates to the works of man, his riches and power, his industrial and commercial operations.

One, among the primary tests of national resources, is the public revenue. The total of yearly revenue and receipts, governmental and local, amounting to £264,000,000 sterling, is unequalled, but falls at the moderate rate of one and a quarter pounds sterling per head of the total of British subjects. There is a large *revenue received throughout the empire for local purposes.* This income (including various receipts, but excluding loans) amounts to hardly less than £61,000,000 sterling yearly; and the greater part is levied by direct taxation.

Another test of power relates to the provision for external defence and internal protection. Now the men trained to arms in the British empire may be stated at 850,000, including the regular British forces

at home and abroad, the militia, and volunteers in the United Kingdom, and in the colonies, the British native forces in India, and other countries. This includes 10,000 Egyptian troops under a British general, but excludes the forces of the native states of India, and of the other countries politically connected with the empire. If, however, the forces of the native states of India were to be added (and they are generally available for imperial purposes), then the total of 850,000 would be raised to nearly 1,000,000. Thus the men under arms, or effectively trained to arms, are in number more than 750,000, and, under the last-named computation, would amount to nearly 1,000,000. The defensive armaments of the empire, by sea and land, cost £41,000,000 sterling annually, or twenty per cent of the total of revenue and receipts. The police for the empire numbers 560,000. Thus we have, for the whole empire, an average of one policeman to every 571 of the people, and to every sixteen square miles.

It is never to be forgotten, that one of the main reasons why the British empire is able to keep its land-forces at a comparatively low scale is its preponderance at sea. The predominance which we hope to find in the British navy will hardly be shown by the enumeration of ships. With this caution, however, it may be stated that there are 246 British war-vessels afloat, or in commission; of which 72 are sailing-ships, and 174 have steam-power. There are now 63 iron-clads, either complete or nearly complete. The number of officers and men amounts to 57,000. The number of iron-clads ready for action at the shortest notice is now 44, of which 25 are at sea.

The mercantile marine has nearly half of the steam tonnage, of the carrying power of the port of entries, and of the freight earnings of all the nations together, and two-thirds of the ship-building. The total trade of the British empire cannot be easily exhibited statistically. However, if the aliquot parts of the trade of the principal nations be computed, then 34 per cent, or one-third of the world's commerce, pertains to the British empire.

The manufactures of the United kingdom are valued at £818,000,000 sterling annually. In general terms, it may be stated, that British manufactures form one-third of those for all Europe put together. The great competitor is of course the United States, where the value appears to exceed that of the United Kingdom. The American manufactures are indeed wonderful, not only in their present magnitude, but in the rapidity of their progress, and in the prospect of their extension.

It follows from these facts, that the wealth of the United Kingdom in land, cattle, railways and public works, houses and furniture, merchandise, bullion, shipping, and sundries, valued at £8,720,000,000 sterling, exceeds that of any European state, and is just double that of Russia. But it is exceeded by the corresponding figure for the United States, namely, £9,495,000,000 sterling. The £8,720,000,000 of British wealth represent a sum seven times the annual income, namely, £1,247,000,000, which seems to be a fair calculation. According to this, the British people earn 14 per cent on their capital, which rate is about the same as that of the United States. It exceeds the corresponding ratio on the continent of Europe. But it is considerably surpassed by the ratios in Canada and Australia, — 18 and 22 per cent respectively.

The construction of public works is a test of national progress. Those works which may here be selected for mention are railways, electric telegraphs, and canals. It is calculated that 46 per cent of the railway traffic of the world is done by the railways of the British Empire: the distances run, however, are less than on the continent of Europe or in the United States. The electric telegraph does six times as much in the old country as in the new.

The total public debt, governmental and municipal, for the British Empire, reaches a total of £1,312,000,000 sterling.

He concluded this statistical summary by adverting to a group of subjects into which moral considerations largely enter; namely, thrift and education.

The decrease of crime and pauperism is satisfactory in the United Kingdom; while pauperism hardly exists in the other dominions of the empire, and the charitable funds raised in the United Kingdom are enormous. The number of patients in the hospitals, though large, is not remarkable relatively to the size of the empire.

Respecting education, there are 5,250,000 pupils at schools in the United Kingdom, 860,000 in Canada, 611,000 in Australia, and 2,200,000 in India, making up a total of 8,921,000 pupils in the British Empire. The fact is, that in India, although education has made a remarkable progress within the last generation, yet the lee-way to be made up was enormous, owing to the neglect of many centuries; and many children of a school-going age still remain out of school. But the comparison attains special interest when made with the United States, where a truly noble progress is exhibited, and where the number of pupils reaches to 10,000,000, the annual expenditure being £17,000,000 sterling. Thus the extraordinary fact remains, that in respect of educational statistics the United States are numerically in advance of even the British Empire.

The religious missions to non-Christian nationalities constitute a bright feature in the British Empire. The statistics of the Roman Catholic missions are not fully known, but their operations are very considerable. The income of the various Protestant missionary societies is hardly less than £750,000 sterling annually, and the number of European ordained missionaries maintained by them is about 900.

ON THE RELATION OF MECHANICAL SCIENCE TO OTHER SCIENCES.[1]

THERE are those who object that section G deals too little with pure science, too much with its applica-

[1] Abstract of an address to the mechanical science section of the British association at Montreal, Aug. 28, 1884, by Sir F. J. BRAMWELL, F.R.S., V.P.Inst.C.E., president of the section.

tions. It may be, as the members of section G might retort, that it is possible to attend so much to pure science as to get into the unchecked region of scientific speculation, and that, had the members of section G been debarred from the application of science, the speculation of Dr. Lardner might to the present day have been accepted as fact.

The speaker thought all men, even though they be followers of science in its purest and most abstract form, must concur in the propriety of section G dealing with engineering subjects generally, as well as with abstract mechanical science. This admitted he would ask — certain what the answer must be — whether there is any body of men who more appreciate and make greater use of the applications of pure science than do the members of this section. Surely every one must agree that the engineers are those who make the greatest practical use, not only of the science of mechanics, but of the researches and discoveries of the members of the other sections of this association.

It would be the purpose of his address to establish the proposition, that not only is section G the section of mechanical science, but it is emphatically the section, of all others, that applies in engineering, to the uses of man, the sciences appertaining to the other sections of the association, — an application most important in the progress of the world, and an application not to be lightly regarded even by the strictest votaries of pure science; for it would be in vain to hope that pure science would continue to be pursued, if from time to time its discoveries were not brought into practical use. The connection between this section and that of mathematical and physical science (A) is most intimate. Without a knowledge of thermal laws, the engineer engaged in the construction of heat-motors will find himself groping in the dark. He anticipated, from the application of thermal science to practical engineering, that great results are before us in those heat-motors, such as the gas-engine, where the heat is developed in the engine itself. Passing from heat-motors, and considering heat as applied to metallurgy: from the time of the hot blast to the regenerative furnace, it is due to the application of science by the engineer that the economy of the hot blast was originated, and that it has been developed by the labors of Lowthian, Bell, Cowper, and Cochrane. Equally due to this application are the results obtained in the regenerative furnace, in the dust-furnace of Crampton, and in the employment of liquid fuel, and also in operations connected with the rarer metals, the oxygen-furnace and the atmospheric gas-furnace, and, in its incipient stage, the electrical furnace. To a right knowledge of the laws of heat, and to their application by the engineer, must be attributed the success that has attended the air-refrigerating machines, by the aid of which fresh meat is at the end of a long voyage delivered in a perfect condition; and to this application we owe the economic distillation of sea-water by repeated ebullitions and condensations at successively decreasing temperatures.

Coming to the mathematical side of section A, whether we consider the naval architect preparing his design of a vessel to cleave the waves with the least resistance at the highest speed, or whether we consider the unparalleled series of experiments of that most able associate of naval architects, the late William Froude, carried out as they were by means of models which were admirable in their material, their mode of manufacture with absolute accuracy to the desired shape, and their mode of traction and of record, we must see that both architect and experimenter should be able to apply mathematical science to their work, and that it is in the highest degree desirable that they should possess, as Froude did, those most excellent gifts, science and practical knowledge.

Passing from section A to section B (chemical science), the preparation from the ore of the various metals is, in truth, a branch of engineering; but to enable this to be accomplished with certainty and economy, it is essential that the engineer and the chemist should either be combined in one and the same person, or go hand in hand.

Reverting to the water-engineer, the chemist and the microscopist have their sciences applied to ascertain the purity of the intended source; and, as in the case of Clarke's beautiful process, by the application of chemistry, water, owing its hardness to that common cause, carbonate of lime, is rendered as soft as the water from the mountain lake.

With regard to the subjects treated by section C (geology), the speaker instanced the Channel tunnel as a case in which, without the aid of geology, the engineer would not be able to give an opinion on the feasibility of the enterprise. The engineers said there is a material, the compact non-water bearing gray chalk, which we have at a convenient depth on the English side, and is of all materials the most suitable. If that exist the whole way across, success is certain. Then came geological science, and that told the engineer that in France the same material existed; that it existed in the same position in relation to other stratifications as it existed in England; that the line of outcrop of the gault lying below it had been checked across; and that, taken together, these indications enabled a confident opinion to be expressed that it was all but certain this gray chalk stratification did prevail from side to side.

To come to section D (biology), the botanical side of it is interesting to the engineer as instructing him in the locality and quality of the various woods that he occasionally uses in his work. With regard to that most important part of the work of D, which relates to 'germs' and their influence upon health, the engineer deals with it thus far: he bears in mind that the water-supply must be pure, and that the building must be ventilated, and that excreta must be removed without causing contamination.

In conclusion, reference was made to the relations of the engineer to the geographical explorer and the student of economic science. The great works, the results of engineering skill, enable the geographer to reach his field of exploration the more readily, and are called into existence by the dictates of the economist.

SOME AMERICAN ASPECTS OF ANTHROPOLOGY.[1]

THE term 'prehistoric' stretches back from times just outside the range of written history into the remotest ages where human relics justify the opinion that man existed. Far back in these prehistoric periods, the problem of quaternary man turns on the presence of his rude stone implements in the drift-gravels and in caves, associated with the remains of what may be called the mammoth fauna. Not to recapitulate details, the point to be insisted on is, how the effect of a quarter of a century's research and criticism has been to give quaternary man a more and more real position. It is generally admitted, that, about the close of the glacial period, savage man killed the huge maned elephants, or fled from the great lions and tigers on what was then forest-clad valley-bottom, in ages before the later waterflow had cut out the present wide valleys fifty or a hundred feet or more lower, leaving the remains of the ancient drift-beds exposed high on what are now the slopes. The evidence of caverns such as those of Devonshire and Perigord, with their revelations of early European life and art, has been supplemented by many new explorations, without shaking the conclusion arrived at as to the age known as the reindeer period of the northern half of Europe, when the mammoth and cave bear and their contemporary mammals had not yet disappeared, but the close of the glacial period was merging into the times when, in England and France, savages hunted the reindeer for food, as the arctic tribes of America do still. The evidence increases as to the wide range of paleolithic man. He extended far into Asia, where his characteristic rude stone implements are plentifully found in the caves of Syria and the foot-hills of Madras. The question with which this section may have especial means of dealing is, whether man likewise inhabited America with the great extinct animals of the quaternary period, if not even earlier, — a question which leads at once into the interesting argument, how far any existing people are the descendants and representatives of man of the post-glacial period. The problem, whether the present Eskimos are such a remnant of an early race, is one which Professor Boyd Dawkins has long worked at. Since he stated this view in his work on cave-hunting, it has continually been cited, whether by way of affirmation or denial, but always with that gain to the subject which arises from a theory based on distinct facts. To be mentioned as preliminary are the questions, Were the natives met with by the Scandinavian seafarers of the eleventh century Eskimos? and, Whereabouts on the coast were they actually found? When the race of bold sea-rovers who ruled Normandy, and invaded England, turned their prows into the northern and western sea, they passed from Iceland to yet more inclement Greenland; and thence, according to Icelandic records, which are too consistent to be refused belief as to main facts, they sailed some way down the American coast. But where are we to look for the most southerly points which the sagas mention as reached in Vineland? Rafn confidently maps out these places about the promontory of Cape Cod, in Massachusetts; and this has been repeated since, from book to book. Mr. Tylor pleaded guilty to having cited Rafn's map, but now felt bound to say that the voyages of the Northmen ought to be reduced to more moderate limits. It appears that they crossed from Greenland to Labrador (Helluland), and thence, sailing more or less south and west, in two stretches of two days each, they came to a place near where wild grapes grew, whence they called the country Vine-land. This would therefore seem to have been somewhere about the Gulf of St. Lawrence; and it would be an interesting object for a yachting-cruise to try, down from the east coast of Labrador, a fair four-days' sail of a viking ship, and identify, if possible, the sound between the island and the ness, the river running out of the lake into the sea, the long stretches of sand, and the other local features mentioned in the sagas, thus throwing light on the southern limit of the Eskimos. The *skrälings*, who came on the sea in skin canoes (*hudhkeipr*), and hurled their spears with slings (*valslöngva*), seem by these very facts to have been probably Eskimos; and the mention of their being swarthy, with great eyes and broad cheeks, agrees tolerably with this. If we may take it that Eskimos eight hundred years ago, before they had ever found their way to Greenland, were hunting seals on the coast of Newfoundland, and caribou in the forest, their life need not have been very unlike what it is now in their arctic home. Some day, perhaps, the St. Lawrence and Newfoundland shores will be searched for relics of Eskimo life, as has been done with such success in the Aleutian Islands by Mr. W. H. Dall; though on this side of the continent we can hardly expect to find, as he does, traces of long residence, and rise from a still lower condition.

Surveying, now, the vast series of so-called native or indigenous tribes of North and South America, we may admit that the fundamental notion on which American anthropology has to be treated is its relation to Asiatic. This kind of research is, as we know, quite old; but the recent advances of zoölogy and geology have given it new breadth, as well as facility. The theories which account for the wide-lying American tribes, disconnected by language as they are, as all descended from ancestors who came by sea in boats, or across Bering Strait on the ice, may be felt somewhat to strain the probabilities of migration, and are likely to be remodelled under the information now supplied by geology as to the distribution of animals. It has become a familiar fact, that the Equidae, or horse-like animals, belong even more remarkably to the new than to the old world. There was plainly land-connection between America and Asia, for the horses whose remains are fossil in America to have been genetically connected with the horses re-introduced from Europe. To realize this ancient land-junction of Asia and America, — this 'tertiary-bridge,' to use Professor Marsh's expres-

[1] Abstract of an address to the section of anthropology of the British association at Montreal, Aug. 28, 1884, by EDWARD B. TYLOR, D.C.L., F.R.S., president of the section.

sion, — it is instructive to look at Mr. Wallace's chart of the present soundings, observing that an elevation of under two hundred feet would make Bering Strait land, while moderately shallow sea extends southward to about the line of the Aleutian Islands, below which comes the plunge into the ocean depths. If, then, we are to consider America as having received its human population by ordinary migration of successive tribes along this highway, the importance is obvious of deciding how old man is in America, and how long the continent remained united with Asia, as well as how these two difficult questions are bound up together in their bearing on anthropology.

To clear the obscurity of race-problems, as viewed from the anatomical stand-point, we naturally seek the help of language. Of late years the anthropology of the old world has had ever-increasing help from comparative philology. Within America the philologist uses with success the strong method of combining dictionary and grammar in order to define his great language-groups; such as the Algonquin, extending from Hudson's Bay to Virginia, the Athapascan, from Hudson's Bay to New Mexico, both crossing Canada in their vast range. But attempts to trace analogies between lists of words in Asiatic and American languages, though they may have shown some similarities deserving further inquiry, have hardly proved an amount of correspondence beyond what chance coincidence would be capable of producing. Thus when it comes to judging of affinities between the great American language-families, or of any of them, with the Asiatic, there is only the weaker method of structure to fall back on. Here the Eskimo analogy seems to be with North Asiatic languages, presenting in an exaggerated form the characteristic structure of the vast Ural-Altaic or Turanian group of Asiatic languages.

The comparison of peoples according to their social framework of family and tribe has been assuming more and more importance since it was brought forward by Bachofen, McLennan, and Morgan. One of its broadest distinctions comes into view within the Dominion of Canada. The Eskimos are patriarchal, the father being head of the family, and descent and inheritance following the male line. But the Indian tribes farther south are largely matriarchal, reckoning descent, not on the father's, but the mother's side. In fact, it was through becoming an adopted Iroquois that Morgan became aware of this system, so foreign to European ideas, and which he supposed at first to be an isolated peculiarity. No less a person than Herodotus had fallen into the same mistake over two thousand years ago, when he thought the Lykians, in taking their names from their mothers, were unlike all other men. It is now, however, an accepted matter of anthropology, that, in Herodotus's time, nations of the civilized world had passed through this matriarchal stage, as appears from the survivals of it retained in the midst of their newer patriarchal institutions. For instance: among the Arabs to this day, strongly patriarchal as their society is in most respects, there survives that most matriarchal idea that one's nearest relative is not one's father, but one's maternal uncle. He is bound to his sister's children by a 'closer and holier tie' than paternity, as Tacitus says of the same conception among the ancient Germans. Obviously, great interest attaches to any accounts of existing tribes which preserve for us the explanation of such social phenomena. Some of the most instructive of these are too new to have yet found their way into our treatises on early institutions: they are accounts lately published by Dutch officials among the non-Islamized clans of Sumatra and Java. Among the Malays of the Padang Highlands of Mid-Sumatra, who are known to represent an early Malay population, not only kinship, but habitation, follows absolutely the female line; so that the numerous dwellers in one great house are all connected by descent from one mother, one generation above another, children, then mothers and maternal uncles and aunts, then grandmothers and maternal great-uncles and great-aunts, etc. There are in each district several *suku*, or mother-clans, between persons born, in which marriage is forbidden. Here, then, appear the two well-known rules of female descent and exogamy; but now we come into view of the remarkable state of society, that, though marriage exists, it does not form the household. The woman remains in the maternal house she was born in, and the man remains in his. His position is that of an authorized visitor; if he will, he may come over and help her in the rice-field, but he need not: over the children he has no control whatever; and, were he to presume to order or chastise them, their natural guardian, the mother's brother (*mamak*), would resent it as an affront. The law of female descent, and its connected rules, have as yet been mostly studied among the native Americans and Australians, where they have evidently undergone much modification. Thus, one hundred and fifty years ago, Father Lafitau mentions that the husband and wife, while, in fact, moving into one another's hut, or setting up a new one, still kept up the matriarchal idea by the fiction that neither he nor she quitted their own maternal house. But, in the Sumatra district just referred to, the matriarchal system may still be seen in actual existence, in a most extreme and probably early form. If, led by such new evidence, we look at the map of the world from this point of view, there discloses itself a remarkable fact of social geography. It is seen that matriarchal exogamous society (that is, society with female descent, and prohibition of marriage within the clan) does not crop up here and there, as if it were an isolated invention, but characterizes a whole vast region of the world. If the Malay district be taken as a centre, the system of intermarrying mother-clans may be followed westward into Asia, among the Garos, and other hill tribes of India. Eastward from the Indian Archipelago it pervades the Melanesian islands, with remains in Polynesia; it prevails widely in Australia, and stretches north and south in the Americas. This immense district represents an area of lower culture, where matriarchalism has only in places yielded to the patriarchal system, which develops with the idea of property, and which, in the

other and more civilized half of the globe, has carried all before it, only showing in isolated spots, and by relics of custom, the former existence of matriarchal society. Such a geographical view of the matriarchal region makes intelligible, facts which, while not thus seen together, were most puzzling. Though it is only of late that this problem of ancient society has received the attention it deserves, it is but fair to mention that its scientific study began long ago, in the part of the world where we are assembled. It is remarkable to find Father Lafitau already pointing out, in 1724, how the idea of the husband being an intruder in his wife's house bears on the pretence of surreptitiousness in marriage among the Spartans. He even rationally interprets in this way a custom which to us seems fantastic, but which is a most serious observance among rude tribes widely spread over the world. A usual form of this custom is, that the husband and his parents-in-law, especially his mother-in-law, consider it shameful to speak to or look at one another, hiding themselves, or getting out of the way, at least in pretence, if they meet. The comic absurdity of these scenes, such as Tanner describes among the Assineboins, disappears if they are to be understood as a legal ceremony, implying that the husband has nothing to do with his wife's family.

It is obvious that in this speculation, as in other problems now presenting themselves in anthropology, the question of the antiquity of man lies at the basis. Of late, no great progress has been made toward fixing a scale of calculation of the human period; but the arguments as to time required for alterations in valley-levels, changes of fauna, evolution of races, languages, and culture, seem to converge more conclusively than ever toward a human period, short, indeed, as a fraction of geological time, but long as compared with historical or chronological time. While, however, it is felt that length of time need not debar the anthropologist from hypotheses of development and migration, there is more caution as to assumptions of millions of years where no arithmetical basis exists, and less tendency to treat every thing prehistoric as necessarily of extreme antiquity; such as, for instance, the Swiss lake-dwellings and the Central-American temples. There are certain problems of American anthropology which are not the less interesting for involving no considerations of high antiquity: indeed, they have the advantage of being within the check of history, though not themselves belonging to it.

A brief account may now be given of the present state of information as to movements of civilization within the double continent of America. Conspicuous among these is what may be called the northward drift of civilization, which comes well into view in the evidence of botanists as to cultivated plants. To see how closely the two continents are connected in civilization, one need only look at the distribution on both of maize, tobacco, and cocoa. It is admitted as probable, that, from the Mexican and Central-American region, agriculture travelled northward, and became established among the native tribes. This direction may be clearly traced in a sketch of their agriculture. The same staple cultivation passed on from place to place. Agriculture, among the Indians of the great lakes, is plainly seen to have been an imported craft by the way in which it had spread to some tribes, but not to others. The distribution of the potter's art is similarly partial. With this northward drift of civilization other facts harmonize. Now that the idea of the mound-builders being a separate race of high antiquity has died out, and their earth-works, with the implements and ornaments found among them, are brought into comparison with those of other tribes of the country, they have settled into representatives of one of the most notable stages of the northward drift of culture among the indigenes of America.

NOTES AND NEWS.

IN order to facilitate the work of the Electrical conference to be held in Philadelphia, the chief signal-officer has issued to the members of the conference the following subjects, as suggested for discussion, with a view to recommending proper observations and reports: 1. What unpublished records exist in the hands of electric-lighting, telegraph, and telephone companies, relative to ground-currents and atmospheric or auroral influences? 2. What is the general experience on east-west, north-south, and other lines? 3. What records can be kept by managers of all lines without interfering with daily business? 4. What special observations can be made? 5. What special lines can be, perhaps, wholly devoted to the continuous record of the phenomena? 6. Do, or can, the noises and currents, as observed on telephone and telegraph lines, give information as to the location and future movement of a thunder-storm, aurora, rain, cold wave, etc.? 7. Are observations on buried lines, or those covered with metallic tubing, or double aërial lines, specially desirable? 8. How can we best secure a complete daily electric survey of a given small portion of country, and a general survey of a larger region? 9. What is practicable in the way of securing a daily map of the distribution of atmospheric and terrestrial electric potentials? 10. Who will maintain self-recording electrometers?

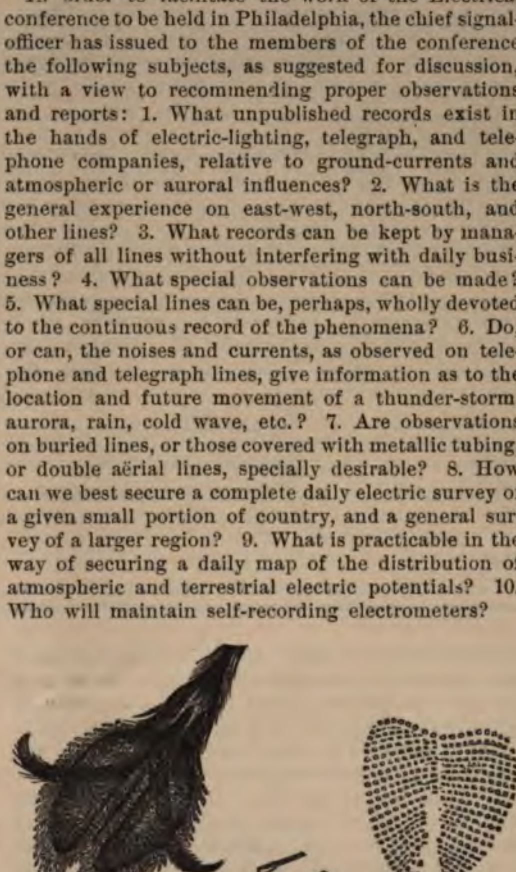
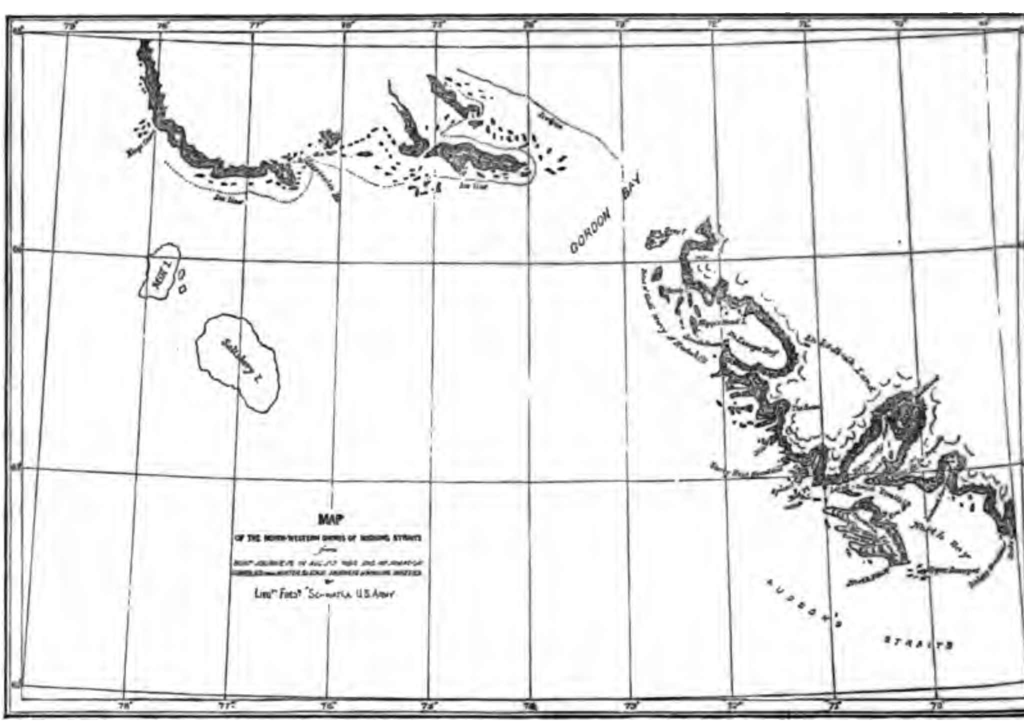


FIG. 1. FIG. 1a. FIG. 2.

— The ability of flies to walk on glass and other polished surfaces receives a new explanation at the hands of Dr. J. E. Rombouts in the *Archives du*

musée Teyler, ser. ii. part 4. He denies the former views, that it is due to pressure of the air, or to the effect of a viscous liquid exuded by the foot, and says that it can be accounted for only by capillary action. In order to study the process, he enclosed a fly in a thin box with a glass plate as a bottom; and, when the box was turned so that the glass was uppermost, the feet could easily be studied under the microscope. The cushions of the fly's feet are distinctly seen to be covered with club-shaped hairs (fig. 1., 1a.) to the number of eight hundred or one thousand, arranged with considerable regularity. From these a fatty liquid is exuded, which leaves on the glass a trace of their contact (fig. 2). The ability to adhere to the glass arises from the attraction exercised by each of these little drops of liquid on the hair from which it is exuded. Various experiments with hairs are recorded to show that capillary force would be sufficient to easily bear the weight of a fly, even were the fluid pure water.

— The accompanying map of the north-western shores of Hudson's Strait is of interest at the present time, on account of the expedition which lately went there under the command of Lieut. A. R. Gordon, to gather information as to the possibility of using the strait in a line of water-connection from the west to Europe. The map was compiled by Lieut. Frederick Schwatka, from surveys made by him while on boat-journeys in August, 1880, and winter sledge-journeys, and from information gathered from whalers, and gives the position of many localities first named by him.



— Dr. Chervin has been studying the medical geography of the department of the Seine Inférieure with reference to disabilities which are developed by the annual conscription. The period chosen covered twenty years. After those cases of feeble constitution, evidently unfit for military duty, the most frequent disability was dental caries, after which followed hernia, etc. In considering the department as a whole, the average number of conscripts rejected on this account was fifteen per cent; but, in considering the separate cantons, it was shown that they vary greatly in this regard, the least average being eight per cent, and the highest nearly twenty-four per cent. In seeking a cause for this singular difference, that sometimes alluded to, the drinking of sour Norman cider, was considered to have little real influence. The question of race was believed to be more important. So far as form and height are concerned, the tables for twenty years showed two physical groups or races, — the smaller in the west: the larger in the east, especially about Dieppe and Neufchatel. The taller race is much more subject to dental caries than the other, and this is confirmed by testimony from other departments. Baldness prevails to such an extent, that two per cent of the recruits examined weie exempt, on that account, at the early age of twenty. Some connection appears to exist between this deficiency and decay of the teeth.

SCIENCE.

FRIDAY, SEPTEMBER 12, 1884.

COMMENT AND CRITICISM.

The American association for the advancement of science borrowed its constitution, in large measure, from the British. Yet, while it is evident in the nature of things that the same rules cannot answer for two countries differing so widely in geographical extent, one weakness of the American, as compared with the British society, lies in its lack of an efficient organization in the interim between two meetings, and the necessity that the non-permanent members of the standing committee should be chosen from and by the members present at one of the annual gatherings. This deficiency has been emphasized by the visit of the British association on this side of the water, and by the proposal for an international association of some sort.

This leads us to draw the attention of those interested to one or two features of the recent Montreal meeting, which might well be adopted by the American association, and would require no alteration of the constitution. One is the grouping of papers in each section, so that those of a similar character are read together, eliciting a better discussion, freer from discursiveness, and at less cost of time; another is fixing set subjects for discussion on some topics of interest, to be opened by designated members; a third is the daily disposal of the entire schedule, no matter how much the papers have to be abbreviated or the session prolonged, so that each day's programme is fresh. The most important of all is the appropriation of grants of money to committees for special scientific work during the year, the grants this year amounting to over £1500.

The growth of the American association, during the past five years, warrants the belief that such grants are entirely within its disposal, if it will simply reverse its plan of printing papers in full. We believe that only five of the numerous papers read at Montreal are to be printed *in extenso;* such papers having to be recommended by the sectional committees, and approved by the general committee. In our own association, the matter is completely within the control of the standing committee, which, by adopting a similar policy, might soon bring the association into possession of a permanent fund of fifty thousand dollars, — such as the British association now enjoys, — instead of leaving it to fulfil but half its mission on its paltry investment of a couple of thousand dollars. At present, the American association is expending more than four thousand dollars a year in printing; while the British association, with twice the membership, and an average presentation of twice as many papers, prints no bulkier a volume, and less than half of it is made up of members' papers. The avenues of publication in America are now ample enough for all papers of permanent value.

It has been justly held, that the meeting of the British association in Canada would produce a direct stimulus to science in the dominion. The association itself has evidently determined that it shall. Welcomed with the utmost cordiality, fostered by the government, and receiving the marked attention of the governor-general, it has raised, among its own members, a science-scholarship fund for McGill University, — probably to be devoted to civil engineering, — has been the occasion of a gift of fifty thousand dollars for a public library in Montreal, and has passed a series of resolutions pointedly calling the attention of the Canadian government to two important duties to science and humanity which it has hitherto neglected, — a proper system of tidal observation along its extended coasts, for the benefit of navigation; and systematic researches upon the native tribes of half a continent.

ETHNIC problems have a natural interest for the American people. Their great task is to fuse together the life of many lands, — to bring political and social union out of the widest diversities that the races of men afford. They follow a true instinct in giving time and public money to such problems. The bureau of ethnology is doing an admirable work in gathering the history of our departing aborigines. There is, however, another field of labor, — one not yet fairly entered on, either by private students or by the ordered phalanxes that are marshalled in the cause of science by the bureaus of the federal government. As the indigenous savages were forced towards the setting sun by the plough-driving Aryans, the shore was crossed by another savage race, the African, that has come to stay for all time in our fields.

There can be no question that the African in the United States presents us with the greatest and most interesting experiment that has ever been tried by civilized man upon a lower people. Around this race have gathered a host of problems of the utmost importance to pure science, and of infinite interest in that field of nature called sociology, into which science is with such difficulty making a slow and blundering way. Out of the very numerous inquiries that should be made in this field we may note the following, that are at the moment, perhaps, the most important because they concern matters that need to be studied at once. *First* among these is the question of the origin of our American negroes. There is a great deal that still can be gathered concerning this question. No close observer of the negro race in this country can fail to have noticed the wide diversity of type masked behind the deceiving uniformity of hue. *Second*, we have the problem of the physical and mental change that has come over this people since their removal to America. *Third*, the effects of climate in different parts of the United States upon these black races, — effects on shape, liability to disease, longevity, etc. What to do with and for the negro, and how to do it, is the question of all questions most immediately and imperatively before us. We best begin to deal with it by making a scientific study of him.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The initiation of deep-sea dredging.

In a recent number of *Science* (July 18), Mr. Rathbun is rather severe upon European naturalists for their supposed ignorance of the fact that the Gulf-Stream dredgings carried on by the Corwin, under the superintendence of the late Mr. Pourtalès, were commenced in 1867, the year before the first British expedition in the Lightning; and he speaks of Mr. Pourtalès' report of December, 1867, as having been 'utterly ignored' by European writers.

It is quite true that no reference was made to this report in the historical account of the subject which formed part of the preliminary report of the dredging operations of the Lightning, presented to the Royal society by Dr. Carpenter on Dec. 17, 1868; for the bulletin of the Museum of comparative zoölogy, which contained Pourtalès' report, had not then reached him. The correspondence between Dr. Carpenter and Sir Wyville Thomson, which led to the cruise of the Lightning (published as an appendix to Dr. Carpenter's report), was carried on in entire ignorance of the fact that Pourtalès had dredged down to a depth of three hundred and fifty fathoms a twelvemonth before. In fact, it was only after their return in September, 1868, that they heard for the first time of the work done by Mr. Pourtalès in May of that and of the previous year. But a short account of it, received from Prof. A. Agassiz, was quoted by Dr. Carpenter; and reference was given to a fuller notice of Mr. Pourtalès' results in Silliman's journal for November, 1868.

It will be seen, therefore, that Dr. Carpenter, far from ignoring the researches of Mr. Pourtalès in the Corwin, fully recognized their priority to those carried on in the Lightning during the autumn of 1868. He could not well refer to a document, which, though published a year previously, had not yet come into the hands of British naturalists, and consequently could not receive from them the credit which Mr. Rathbun says has been denied it. But Mr. Pourtalès' dredgings were noticed in the same number of the proceedings of the Royal society as were those of the Lightning; and I do not well see how their value could have been more fully recognized, considering what was then known about them in this country.

I freely admit, however, that in 'The depths of the sea,' the book to which Mr. Rathbun so pointedly refers (though without naming it), it is stated that the dredgings of Mr. Pourtalès were 'commenced' in 1868. This is one of several minor inaccuracies which are unfortunately to be found scattered through the work; and, however much they are to be regretted, it must be remembered that at the time it was written the author was in bad health, with his time fully occupied by his professorial duties, and by the preparations for the cruise of the Challenger, which commenced almost before the book was in the hands of the public. In fact, the later chapters, which contain the erroneous reference to the date of

Mr. Pourtalès' first dredgings, were written under very considerable difficulties, as I well remember hearing from the author himself. But the 'priority in scientific research,' which Mr. Rathbun claims for Pourtalès' work, had been accorded to it four years previously, at the earliest possible opportunity, in the Proceedings of the Royal society. So far as I know, this honor has never been 'denied' to one who would have been the last to claim it for himself. I fully admit, however, that the date of his earlier work has been incorrectly given in certain popular accounts of the subject; but this was done accidentally, and without the slightest intention of appropriating any credit for the work of British naturalists which was justly due elsewhere, as will be evident from what I have said already.

P. HERBERT CARPENTER.

Eton college, Windsor, Eng., Aug. 11.

The 'bassalian fauna;' 'Pentacrinus asteriscus.'

I notice that Mr. Gill has "recently proposed the name 'bassalian realm' for the collective deep-sea faunas." I do not know whether it is proposed to define this name more strictly by assigning to it any particular bathymetrical limits; but it may be well to notice, that, in his presidential address to the biological section of the British association at Plymouth in 1877, Mr. Gwyn Jeffreys suggested the use of the name "'benthal' (from the Homeric word βένθος, signifying the depths of the sea) for depths of one thousand fathoms and more," while retaining the term 'abyssal' for depths down to one thousand fathoms.

There is another point to which I have long thought of directing the attention of the readers of *Science*, and I therefore take this opportunity of doing so.

The surveys of Hayden, Wheeler, and others, in Utah, Idaho, and Wyoming, have revealed the very wide distribution, in beds of Jurassic age, of a crinoid which has been called Pentacrinus asteriscus. Nothing is known of this form but a number of stem-joints (I speak under correction, and shall be pleased to hear that I am wrong); but most of the figures of these joints which I have seen (e.g., that given by White in the paleontology of Wheeler's survey) seem to me to indicate that the type should be referred to Extracrinus rather than to Pentacrinus. The essential characters of the stem-joints of Extracrinus are well shown in plate liii. of Buckland's 'Geology and mineralogy,' figs. 9–13; on tab. 101 of Quenstedt's 'Encriniden,' especially figs. 24, 27, 33, and 37; and also on plate xii. of the Austins' 'Monograph of recent and fossil crinoids.' The five interradial petals are quite narrow, and much less distinctly oval than in Pentacrinus, sometimes becoming almost linear, with rounded outer ends. The interpetaloid spaces are plain, and devoid of sculpture; while the markings at the sides of the petals are much more delicate than in Pentacrinus, having more the character of striae or crenulation than of coarse ridges. They are also much more numerous than in Pentacrinus, and are limited to the sides of the petals, not reaching the outer edge of the joint-face. Under these circumstances, I suspect that it is to Extracrinus, and not to Pentacrinus, that we must refer the joints which were described by Meek and Hayden as having lance, oval, petaloid areas, "bounded by rather narrow, slightly elevated, transversely crenulate margins."

Extracrinus was proposed by the Austins for the two well-known liassic fossils, Pentacrinus briareus and P. subangularis; but recent investigations have shown that the genus extends up into the great oolite (Bathonien) of Britain, France, and Switzerland. I have no knowledge, however, of any triassic species of Extracrinus; though Pentacrinus is well represented in the St. Cassian beds, and has been found associated with Encrinus in the 'wellenkalk' of Würtemberg.

It is therefore interesting to find that the triassic form of Pentacrinus asteriscus, which was obtained by the fortieth parallel survey from the Dun Glen limestone and the Pah Ute range, differs from the Jurassic specimens found in south-east Idaho and western Wyoming, almost precisely in those points which distinguish Pentacrinus from Extracrinus. According to Hall and Whitfield, the chief distinction of the triassic forms lies "in the more obtuse points of the star, and the filling-up of the angles between the points, and also in the broader form of the elliptical figures on the articulating surfaces of the disks." They suggest that the differences may possibly be of specific value; but, having carefully studied a large variety of stem-joints of Pentacrinidae, both recent and fossil, I am inclined to go farther, and to suspect that the triassic type may belong to Pentacrinus, but the Jurassic form to Extracrinus.

The two genera differ very considerably in the characters of the calyx and arms, as will be fully explained in the report on the Pentacrinidae dredged by the Challenger and the Blake, which will appear in the course of the winter. But, in the mean time, I shall be most grateful for any information respecting Pentacrinus asteriscus, in addition to that which has been already made public; and I need not say that I should much like to have the opportunity of making a personal examination, both of the triassic and the Jurassic specimens.

P. HERBERT CARPENTER.

Eton college, Windsor, Eng., Aug. 11.

Points on lightning-rods.

The following passage occurs in J. E. H. Gordon's excellent "Physical treatise on electricity and magnetism," vol. i. p. 24: "It was held that the knobs [on the ends of lightning-rods] must be most efficacious, because the lightning was seen to strike them, and never struck the points. The fact that a point prevents the lightning from ever striking at all was not known."

This is not true. The highest rod on my house is some fifteen feet above the others, and about thirty feet higher than the surrounding buildings; and yet, notwithstanding the fact that it is tipped with a brush of five points, it was struck a few years ago. The points are gilded iron, and the topmost one was melted into a ball about one-eighth of an inch in diameter. The rods are all connected by horizontal pieces held about three inches from the tin roof by glass insulators, after the fashion of ignorant lightning-rod agents. The neighbors say that the sparks flew so thickly between the rods and the roof, as to resemble a sheet of flame. The shock was, singularly enough, so slight that it is doubtful whether it was due to the electrical discharge, or the deafening crash of thunder that instantly followed the splitting sound of the spark.

A. B. PORTER.

Indianapolis, Aug. 23.

Photographs of the interior of a coal-mine.

One of the most interesting enterprises to which the preparations for the New Orleans exposition have

given rise is the successful attempt to photograph the interior of a coal-mine in Pennsylvania. The mine selected for the experiment was the Kohinoor colliery at Shenandoah, operated by the Philadelphia coal and iron company, from whose representatives all necessary facilities were obtained.

The experiment was conceived of, and successfully carried out, by Mr. James Temple Brown, who was sent out from the metallurgical department of the National museum to collect specimens illustrative of the coal industry. An attempt was first made to photograph by the aid of magnesium light, but the results proved unsatisfactory. The Arnoux electric-light company then volunteered to supply an electric plant, and to erect and take charge of it gratuitously. The five negatives obtained by the use of this light were highly satisfactory, and show some features of coal-mines which probably have not hitherto been seen by scientific men, nor, indeed, by miners themselves, whose feeble lamps give them only a glimpse of the immediate surroundings.

The photographs will be enlarged, and exhibited at the New Orleans exposition. Whatever credit attaches to this somewhat novel undertaking is due primarily to the generous encouragement of the director of the museum, and to the thoughtfulness and energy of Mr. Brown. The representatives of the Philadelphia coal and iron company very kindly gave the matter their personal attention, and the photographer employed for the work labored enthusiastically for the results obtained.

F. W. TRUE.

U. S. National Museum, Sept. 5.

ELECTRICAL TESTING ESTABLISHMENTS.

THE *Electrical review* seconds the suggestion of the *Engineer*, that an 'electrical testing establishment' be founded in England, where any ambitious inventor may find the apparatus and conveniences which he may need for a proper testing and perfecting of his ideas. The *Review* calls attention to the impossibility of a poor man, however ingenious he may be, being able to work upon any improvement in cable telegraphy, as at least an artificial cable must be at his command, — a necessity which would cost him several thousand dollars. In the same way with experiments on electric lamps: the cost of the necessary plant is very considerable, and the amount required for supplies to be used in constant trials is by no means to be neglected.

The founding of such an establishment for the aid of inventors has been suggested by several of the successful members of the class in America, but has not, we believe, been carried out. There would, at the start, be the difficulty of deciding as to the worthiness of any scheme which might be brought forward for development. The inventor is necessarily an enthusiast, and an extremely fickle being, who would come in one morning all aglow for a new form to be given the carbon filament in an incandescent lamp, and the next would have nothing of lamps, but would earnestly urge some peculiar construction of telephone-cable to get rid of the 'cross-talk.' This constant jumping, accompanied by the necessary amount of perseverance, leads him finally to some goal, but at the same time makes him an obnoxious companion to the steady-going workman who must needs follow him, nothing being more discouraging to an artificer than to see the results of his one day's work overthrown on the next.

It may be urged, that the man with capacity for improving the methods of the world's work will sooner or later, but surely, push himself forward into a position where he can help himself through a connection with some rich telegraph, electric-light, or manufacturing company, where his powers will have full play, and his suggestions be listened to and put in effect. It should also be considered whether, in establishing any 'helping-hand' arrangement, the principal or only result would be to assist those for a time who give promise of valuable development, but who are lacking in the strong fibre necessary for successful accomplishment. Notwithstanding all objections, it may appear to some that the possibility of enabling some one worthy man to bring his work to perfection ten, twenty, or thirty years before he could if left to his own unaided resources, would justify the expenditure of considerable sums on what would be found to be the chaff of inventions. What the result might be, is very difficult to say. There might be some very successful work done in such a laboratory, properly guarded, and where the applicants were kept as constantly as might be to their purpose: there certainly would be a vast number of cranks knocking at the door.

The editorial in the *Electrical review* brought

out a response from one of the 'electrical schools' of England, which shows the result of the trial of such a method of aiding inventors, although a free use of the laboratories could not be offered. In this reply it is stated that the school has for several years openly offered the facilities of its laboratories to any inventor who may come forward, and wish such facilities to aid him in perfecting his work; and that as yet they have received two applications, both of which were withdrawn on account of the remuneration which the school felt called upon to ask. One of the applicants was a cable company, and considered five shillings a day too much for the use of the very extensive apparatus required; and the other looked upon five pounds as excessive for the use of power and a dynamo, with skilled superintendence and advice.

As the most feasible solution, for the present, of the question, how to advance the uses of electricity, many of our large telegraph, telephone, and electric-light companies have established testing-laboratories for the use of their employees, and give regular employment to professional inventors whose researches are directed by the officers of the company; but little is done in these laboratories to promote research by persons not connected with the companies themselves. Our universities and technological schools, in many cases, possess well-equipped physical laboratories, containing electrical testing-apparatus for the use of the students. These laboratories exist for the purpose of promoting research, and might, under suitable restrictions, be thrown open to inventors as well as to students.

However the difficulty is to be met, it is undoubtedly the case, that research looking to the utilization of electricity as a motive power and as a source of light is fettered and hindered by the expense of the apparatus required. If a special laboratory, to be under the direction of suitable persons, could be established in this country for the promotion of electrical research, especially for research in those branches that necessitate the employment of expensive apparatus, invention in these branches would be stimulated, and the whole community would be the gainer. In France the profits of the late International electrical exhibition have been devoted to the establishment of an electrical laboratory. Perhaps the managers of the forthcoming electrical exhibition in Philadelphia may take the hint.

AMERICAN APPLIANCES FOR DEEP-SEA INVESTIGATION.—TRAWLS AND TANGLES.

Beam-trawls.

THE beam-trawls designed for zoölogical collecting have usually been patterned closely after those employed by the English fishermen, and in this form are well adapted for moderate depths of water. In fact, the only objection to their use in great depths is their liability to capsize while being lowered, often causing them to land upon the bottom wrong side up. They were first employed on this coast by the fish-commission in 1871; and the earliest records of their use by the English, in deep water at least, are given in the Challenger narrative (beginning in 1873), no reference being made to the subject of beam-trawls in the account of the voyages of the Lightning and Porcupine. In all the exploring-work of the fish-commission, the beam-trawls have been used quite as frequently as the dredges; the trawling-results being far richer as to the larger forms of life, and including immense numbers of fishes which could never be obtained by the dredge, and would otherwise have remained undiscovered.

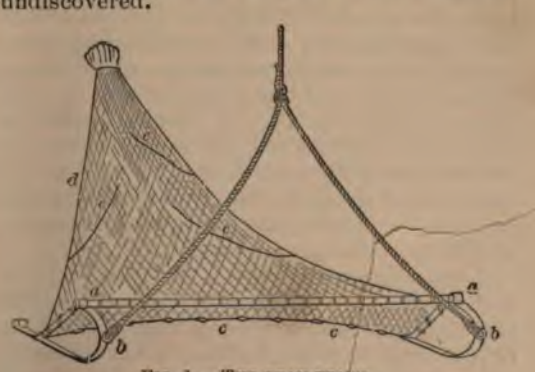


FIG. 1.—THE BEAM-TRAWL.

As is known to most naturalists, the beam-trawl (fig. 1) consists of a large, tapering, bag-like net, which is dragged over the bottom, mouth forwards, to entrap such fish as live close to the ground. The mouth is held open

by a long beam, generally of wood, supported upon iron runners; and there are one or more inner, funnel-shaped traps, to prevent the escape of fish after they have entered. The nets are sometimes very large, and the beams often measure forty-five or fifty feet in length. The lower side of the mouth of the net, which is leaded, hangs loose, so as to drag over the ground in a deep backward curve. It does not dig into the bottom, but simply scoops into its capacious mouth every loose object lying in its course. Large quantities of soft sand and mud are, however, often taken up.

In adapting the fishermen's trawl for zoölogical work, a few modifications have been made, mainly as regards size and the materials used in its construction. For small trawls a beam of iron gas-pipe is now preferred by the fish-commission to wood, as being more durable, less bulky, and less liable to injury from pressure in deep water; the defect of wooden beams, in the latter respect, having seriously inconvenienced the deep-sea trawling operations of the Challenger.

The different sizes of trawls employed vary, in the length of beam, from seven and a half to eighteen feet, a wooden beam being used for the latter size only. With an eleven-foot beam, the runners measure twenty-eight inches in height and four feet in length, the beam having a diameter of two inches and a quarter, and screwing into brass strap bands on the tops of the runners. The openings through the runners are closed by netting. In the smaller trawls the net is about eighteen feet long, with a single pocket, and, in the larger, measure from twenty-five to forty feet in length, with either one or two pockets.

For the greater depths of water, the eleven and fifteen feet beams are preferred. The largest size is seldom used, except in moderate depths; and in shallow water, the Otter trawl, another English pattern, is not unfrequently employed.

The common beam-trawl has been used successfully by the fish-commission in all depths down to 2,949 fathoms, the latter indicating the deepest trawling-station on record for the Atlantic Ocean. The Challenger trawled to a depth of 2,650 fathoms in nearly the same locality, but in the Pacific Ocean made several successful casts in more than 3,000 fathoms, the trawl they had having been of about the same size and pattern as the American.

The method of attaching the bridle in the Challenger trawl was similar to that afterwards adopted for the Blake trawl, the bridle ropes being made very long, and extending along the sides of the net to its extremity, with lashings to the runners on each side, and to the hinder end of the bag. The object of this arrangement of the bridle was not stated by Sir Wyville Thomson; but it was presumably to allow the forward fastenings to break, in case of fouling, and permit of the net being hauled up hind-end first.

The Blake trawl.

The objection above raised to the use of the ordinary beam-trawl in deep water suggested to the officers of the Blake dredging-party, in the winter of 1877–78, the construction of a reversible trawl, having in this respect all the advantages of the naturalists' dredge. This pattern, termed the 'Blake trawl,' or 'double beam-trawl,' bears the same relation to the fishermen's beam-trawl as does the naturalists' dredge to the oyster-dredge; the changes in both cases being demanded by the necessity of working with greater precision in deep water, where the loss of time occasioned by the use of ill-suited appliances cannot well be afforded.

FIG. 2.—THE BLAKE TRAWL OR DOUBLE BEAM-TRAWL. IN USE (OR IN POSITION FOR DRAGGING ON THE BOTTOM).

The Blake trawl (fig. 2) was the joint invention of Mr. Alexander Agassiz, Commander Sigsbee, U.S.N., and Lieut. Ackly, U.S.N., and was used with great success on the several dredging-cruises of the steamer Blake from 1878 to 1880, undergoing, during this time, a few slight improvements to perfect its working. In 1880 it was adopted by the fish-commission for deep-water work, in connection with the old pattern; and in 1883 it was also copied by the French exploring-steamer Talisman. The following description is made up from one of the trawls belonging to the latter party, and differing but slightly from that of the Blake.

The runner-frames, made of bar-iron half an inch thick by three inches wide, form a very broad D-shaped figure, being equally curved above and below in front, and extending thence straight back to the upright hinder end, beyond which the runners project slightly, the overlapping portions being perforated for the attachment of the net. These frames measure three feet and a half in height by four feet in length, and are rigidly connected by two beams of iron gas-pipe, ten feet and three-quarters long and two inches and a quarter in diameter, which screw into brass collars riveted to the inner sides of the runners, — one in front, and one behind. The net, like the frame, is perfectly symmetrical in shape, and consists of a cylindrical or slightly conical bag of stout twine webbing, open at the lower end. Its length may vary from eighteen to twenty-five feet; and, to give it increased strength, a double thickness of webbing is generally employed. The folds formed in tying the lower end of the net for use serve to retain a certain quantity of the fine bottom-material.

The method of attaching the net to the runner-frame is simple. A two-and-a-quarter-inch rope runs around the entire mouth, and is laced to the hinder ends of the runners, and secured to the four hinder corners of the same. In common with the mouth of the net, this rope is left sufficiently slack between the runners on both sides; so that, whichever side is uppermost, the slack of that side curves down to the level of the beams, and does not obstruct the lower half of the opening: the lower slack line naturally curves backward upon the ground. These slack portions of the line are weighted to serve as lead lines.

There is an inner pocket, or trap, to the net, and a series of four glass or cork floats to assist in keeping it expanded. The runner-openings, and the space between the beams, are also closed in with netting. The bridle for the attachment of the drag-rope may be fastened to the fronts of the runners, or carried back to the hinder end of the net, as before explained. Other methods of arranging the net have been tried, but that above described has proved most satisfactory.

Trawl-wings.

It has long been observed, that enormous quantities of small and delicate free-swimming animals, especially Crustacea of the lower orders, come up completely crushed in the mass of material which frequently fills the trawl; and it was also evident that still larger quantities must escape through the coarse meshes of the net. To collect and preserve these forms, Capt. H. C. Chester arranged in 1880 for the use of the fish-commission, in connection with the beam-trawls, a large towing-net, having a rectangular mouth-frame of iron three feet long by eight inches wide, and a moderately fine mesh bag of netting about three feet in length. Into the lower end of this bag is fitted one of the ordinary silk or linen towing-nets for the purpose of retaining the very smallest objects. Two of these towing-nets are fastened to each trawl of either pattern nearly every time they are used; being attached, one at each end of the beam (as shown in fig. 3), by means of a piece of small

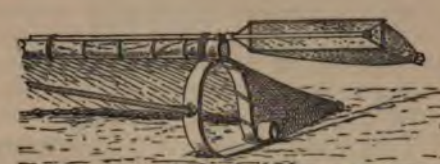


FIG. 3.—THE TRAWL-WINGS ATTACHED TO THE BEAM-TRAWL, IN USE.

gas-pipe lashed by one end to the beam, or extending a short distance into it, if the latter is also of iron. The trawl-wings, as these nets have been christened, give such excellent results, that their appearance at the surface, after a haul, is as anxiously watched for as is that of the trawl proper.

Tangles.

While the use of hempen tangle-swabs attached to the dredge was introduced by the English exploring-steamer Porcupine in 1868 or 1869, the idea that they were worthy of being used separately appears to have originated with Professor Verrill of the fish-commission in 1871; since which time other explorers, both European and American, have employed them to a slight extent in the same way. It has been the experience of this commission, that the combination of tangles with the dredge or trawl is, to say the least, cumbersome; and, following in the wake of either, they generally pick up only the more or less mutilated specimens which have been injured by the iron scrapers or the lead line. By attaching them at the sides, however, as is sometimes done, the latter objection is removed.

The true province of the tangles is a very rocky bottom, where neither the dredge nor

trawl can be safely used; and here they perform a real service, notwithstanding the impossibility of extricating the delicate specimens

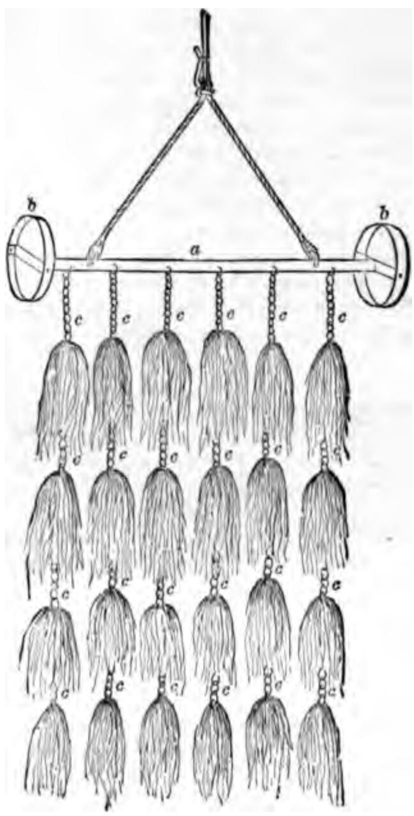


FIG. 4. — THE TANGLES (VERRILL'S PATTERN).

from the hempen swabs without injury. They may also be employed on moderately rough bottoms to supplement the work of the dredge; but, used separately, both have, by actual experience, been proved to obtain far better results. On smooth bottoms, it does not seem rational to suppose that the tangles can in any way add to the results afforded by the beam-trawls, properly managed; and several trials, made on rich ground of this character, have shown such to be the case.

A short distance beyond the coast-line, we generally come upon such uniformly smooth bottom, that the beam-trawl can be trusted nearly everywhere. Working in such a region as this, enormous hauls would be obtained day after day; the trawl delivering its specimens in exceptionally good condition, and affording the full variety of life which existed there. During the earlier part of the explorations, alcohol was used at the rate of two to three barrels a day, and certainly better results could not be asked for. At intervals the tangles would be lowered, but they never furnished anything new; and the pitiable condition of the specimens they brought up, when compared with those from the trawl, caused their use to be discontinued. And what more could be expected of them, when attached to the runners or net of the trawl?

The tangles devised by Professor Verrill, in 1871, were secured to a triangular iron frame, similar to that of the rake-dredge. In 1873, however, they were altered and improved as represented in fig. 4.

They consist of an iron bar, rigidly attached to two rings or wheels, as a framework, from which extend several small iron chains, each carrying from three to five hempen swabs of medium size. The wheels are not intended to revolve, but merely to keep the bar above the ground, so as to prevent its coming in contact with the specimens; and whatever injury befalls

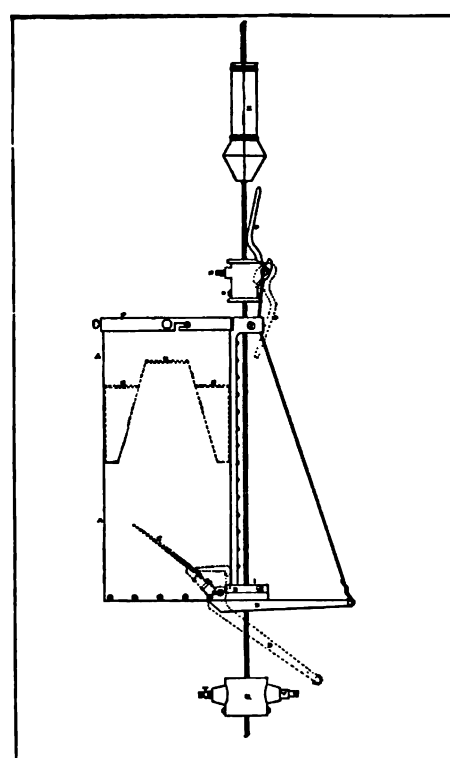


FIG. 5. — SIGSBEE'S GRAVITATING TRAP.

the latter must result from their entanglement among the hempen fibres.

Towing-nets.

As to the towing-nets for collecting at the surface, and at depths intermediate between the surface and the bottom, we have but a single noteworthy improvement to mention, — the gravitating-trap of Commander Sigsbee, which was successfully worked on the last dredging-cruise of the steamer Blake. It is designed to traverse rapidly any given vertical space at any required depth, for the purpose of determining the character and abundance of life at different levels. It does not, however, afford the means of obtaining continuous horizontal towings at intermediate depths, unmixed with the life of higher levels; such a result being still a subject for future investigation.

The gravitating-trap (fig. 5) consists of a brass cylinder, two feet long by forty inches in diameter, riveted to a wrought-iron frame, covered with gauze at the upper end, and having a flap-valve opening inward at the lower. It is suspended to the wire dredge-rope on which it travels, by means of a friction-clamp; while at the point below, to which it is to descend, there is a friction-buffer. The weight of the cylinder and its frame, from the manner in which they are suspended, keeps the valve closed until the apparatus has been lowered to the highest level from which it is desired to take the specimen. Every thing being in readiness, a small weight or messenger is sent down the rope, which, on striking the friction-clamp, disengages it, allowing the cylinder-clamp and messenger to descend by their own weight to the buffer. As the cylinder strikes the buffer, the valve closes, and is held in this position, during the hauling-back, by the weight above it. This implement may be worked at any depth, and the distance traversed by the cylinder may be regulated at will. The many details of construction have been purposely omitted.

For the ordinary towing-nets for surface-collecting, and for use in connection with the trawl-wings, silk bolting-cloth, which can be obtained of any size of mesh, has been substituted for the various other kinds of cloth formerly employed. Bolting-cloth, though moderately expensive, is very strong and durable, and the nets constructed of it have given great satisfaction. The towing-net frames are made of heavy brass wire, and are generally circular in shape, though an elongated rectangular frame is sometimes employed.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE PHILADELPHIA MEETING.

We have made arrangements for publishing reports and abstracts of so many of the papers presented at Philadelphia, that our readers can soon judge for themselves of the scientific importance of the meeting; and we shall therefore restrict our editorial comments, this week, to some general impressions which were formed during the progress of the session.

The intense heat of the first five days was a serious drawback from the pleasure of attendance, but it was the only drawback. It doubtless deterred from the journey a few who would otherwise have been present; but the arrangements of the Philadelphians were so complete, that those who were in the city encountered the minimum of discomfort, and enjoyed the utmost benefits which a great convention can afford. It was particularly fortunate that Saturday was kept free from all sessions, for many persons were thus enabled to devote two days to refreshment by the seashore or in the mountains in the company of their associates and friends. Every thing which could be done by an enlightened and wealthy community, devoted to hospitality, was done to show an interest in, and respect for, the workers in science, American and foreign. Nothing was forgotten or neglected. The permanent officers of the association did their part with the most satisfactory efficiency. Museums, libraries, and collections were freely opened; and the electrical exhibition, though not complete, was far enough advanced to be an attractive and instructive show. The convention of the mining engineers, and the convention of Agassiz clubs, augmented the number of attendants upon the meetings.

The public interest in the sessions, as usual, reached its height at the delivery of the presidential address. On this occasion, Professor Young, as our readers have already discovered, presented a masterly review of the present condition of astronomical science and of the problems which next invite attack. With many bright flashes, his discourse was as orderly as the solar system; and he balanced this view and that with the skill of a trained physicist. It is rare on such anniversaries for

a speaker to be so felicitious in the choice and treatment of his theme. We trust that our readers will pardon us for saying, that by the kindness of the lecturer we were able, at the close of his discourse, to distribute the number of *Science* in which it was printed.

We are inclined to think that the custom which puts the president's address in the evening is unwise. It is usually an elaborate essay, depending for its interest more on its matter than on its style; though, in this, style and matter were both excellent. Sometimes, as at the present session, very close attention must be given by ordinary listeners if they would seize the points of the discourse. Why should this lecture be given in the evening, when everybody is tired, when the gas augments the solar heat, and when many are impatient for the social entertainment which is to follow? Why should it not be delivered at a morning session?

So far as the daily newspapers came under our eye, there seems to be a great falling-off in their abstracts of the papers. The reporters seem to be in despair as to what to select from the superabundance of material, and in many cases their choice is hap-hazard. Indeed, it is very difficult for any one to determine from the programme what will be of most interest, or exactly when particular papers will be read. Some 'sifting' or 'grinding' committee seems indispensable to eliminate such papers as are for any reason inappropriate to these gatherings. There should be a survival of the fittest, and the rest should disappear.

We trust the day will come when it will be considered the mark of a bad education to read or speak indistinctly in public, — when bad utterance will be as great an offence against the usages of good society as bad grammar or bad spelling. More than one speaker in Philadelphia has thwarted his own purposes by his low, inarticulate, or suppressed vocalization. Instead of awaking an interest, he has smothered it. Why should college professors speak so poorly as many of them do?

So far as our observations go, the most useful meetings of the sections appear to be those in which a discussion is provoked upon some interesting question, not necessarily on a new point. For example, such debate as took place in the mechanical section, on instruction in mechanics; or that in the physical section, on thunderstorms; or as that proposed in the chemical section, on the best methods of teaching chemistry, — are valued by all who are present, more, even, than elaborate papers which can hardly be appreciated until they are printed.

The 'special committees' of the association did not appear in a very efficient aspect, when the long list of them (eleven in number) was called Monday morning, with but one written and two oral responses. We may also add, that better modes of promoting the work of the association can be devised than these 'general sessions,' which consume the best hour of the morning, and really accomplish very little good.

The number of members enrolled as present, up to Tuesday morning, was 1,157; and many more have since arrived. The members of the British association have been received with great cordiality; and every proposal to continue the friendly relations which have been fostered this summer, and all proposals looking toward an international scientific congress, are received with great favor.

As a whole, we are sure that the Philadelphia meeting is one of the best, if not the very best, which has ever been held.

COLLEGE MATHEMATICS.[1]

PROFESSOR EDDY announced as the subject of his address, the present state of mathematical training in our colleges; its aims, its needs, and its relations to education and to scientific research. It is an article of faith firmly held and oft expressed by the undergraduate, that higher mathematics is a study which can be thoroughly mastered only by exceptional geniuses. One very bad feature in this state of things is, that this sentiment respecting mathematical study is not confined to undergraduates, but is largely shared, not only by the faculties in general, but by the instructors and professors of mathematics as well.

There are various reasons which have led mathematical teachers to this opinion, besides the ill success that has attended their efforts with their pupils. It must be admitted that, too often, the instructors themselves have not become engrossed in their studies, perhaps not even interested in them. That we have in this country no large body of men whose life-work has been, day by day, directed in the line of mathematical investigation, is evident to all. The paucity of important mathematical investigations emanating from this side of the Atlantic is proof of it. But even where the professorial chair is filled by an eager and brilliant mathematician, he often feels the hopelessness of initiating his pupils into this all-absorbing realm of thought in the few brief months at his disposal. Thus it has come to pass, that the study has been used simply as a form of mental discipline or intellectual gymnastics: the object sought

[1] Abstract of an address to the section of mathematics and astronomy of the American association for the advancement of science, at Philadelphia, Sept. 4, by Prof. H. T. Eddy of the University of Cincinnati, vice-president of the section.

was not to learn how to use this the most splendid instrument of intellectual research yet devised by the wit of man.

There is an underlying consciousness running through the whole scheme of education based upon classical study, that the objects of such study are not in themselves of vital importance to the student, but that their value is chiefly to be found in the reflex influence upon the person submitting to its discipline. Pretend to deceive ourselves as we may upon this point, the undergraduate feels this with every breath of his young life. Professor Eddy did not take the position that classical study is in itself a delusion, nor that the ancient languages and philological science are not most worthy and inspiring objects of study for those who really intend to know something of them, or for those whose tastes and capacities fit them for their pursuit; but that this demoniacal spirit of study for the sake of discipline, which possesses our colleges, must be cast out before they can rightly train classical scholars, or stand where they should stand in the forefront of higher culture in the liberal arts: and this by the introduction of a spirit of study very different from the disciplinary spirit,—a spirit which, for the lack of a better name, we may call the scientific spirit; a spirit of sincere and earnest inquiry after knowledge.

There is apparently no reason why the spirit which so largely animates scientific study should be confined to that kind of study, for it is not the nature of the study which determines the spirit in which it shall be pursued. Mathematics is a case very much in point in this regard. The truth is, young men of spirit will not shirk hard work, if they are convinced that by it they can open up any fair field of knowledge which appears desirable. And the speaker said, that, under such influences, he had seen students gain, during the first half of their college course, such familiarity with those branches of higher analysis which are the common groundwork of modern investigation in analytical mechanics and mathematical physics, as to have really open to them the literature of these subjects; and this not in isolated instances merely, but with class after class. It is popularly supposed, as before stated, that the number fitted by nature for mathematical study is small. Such, Professor Eddy has been convinced against his preconceived opinions, is not the fact. It is a study as much sought after, and pursued as eagerly, as any other branch of liberal study; provided only that the teachers thereof are themselves men who have a live interest in the subject, are capable, patient, and apt at giving instruction.

Professor Eddy then discussed somewhat more in detail the scope of mathematical instruction in college. The geometry of Euclid, which should be relegated to the schools, has long held a part of honor in the mathematics of the college course. The cause for this is easily seen. It is a subject which lends itself, more readily than any other branch of mathematics, to the form of discipline in vogue. It certainly is a matter of vastly more importance as a piece of mathematical training, to have the student of Euclid acquire the habit of discovering for himself the demonstration of new propositions, than that the study of Euclid should be made a huge memoriter exercise, as is usually done in college. The clear apprehension of geometrical relations, aside from the language describing them, is of the first importance, and may be cultivated by any work which deals with such relations.

Several other mathematical subjects could well be covered before entering college. These are the elementary parts of algebra, the numerical solution of plane triangles, the practical use of logarithmic tables, and the elementary ideas of analytical geometry. The field would then be cleared, so that the training in all those forms of analysis which are distinctively modern, and which must needs be taught by men in sympathy with its methods, would fall within the years of the college course.

Objection may be made to the amount of mathematical preparation which it is here proposed to put into the schools.

But what ought the actual scope of mathematical instruction to be during the college course?

It seems superfluous to say, that, without the mastery of the infinitesimal calculus, any mathematical culture of importance is hopeless; and that a knowledge of its methods, accompanied by facility in their employment, is absolutely essential to the understanding of the exact sciences.

Calculus is not omitted from the scheme of study of any classical college in this country; but it is hardly too much to say, that, so far as any real knowledge of it is concerned, it might as well be omitted from them all.

The text-books in use are of such very elementary and defective character, that no sufficient knowledge of the subject can be obtained from them. They are constructed on the plan of omitting almost every thing which may present any special difficulty. It has been in effect assumed by those imbued with the disciplinary spirit, that a knowledge of this subject could be conveyed to the student by daily recitation upon its principles and developments. This is as useless an attempt as to try to prepare an army for the battle-field by a daily lecture instead of a daily drill, or by explaining tactics instead of practising them. The important processes actually employed in calculus are not so very numerous, nor are they especially difficult to acquire. No real use, however, can be made of its methods until these are acquired. It must often happen that the full significance of such processes is not apprehended until long after they are employed with dexterity. Certain it is that such dexterity and familiarity conduce wonderfully to their correct comprehension.

The daily marking system is perhaps the most characteristic and most pernicious expression of the college disciplinary spirit. How have the evils of that system been intensified in our larger colleges by the wholesale manner in which the work is done! The work of recitation and instruction can, no doubt, often be advantageously combined; but what is the probability that valuable instruction will be commu-

nicated during the hour to which the exercise is confined, when the number of students in the recitation-room is thirty, forty, or even fifty? What a perversion of the purposes of the noble endowments for higher education, to expend almost the entire energy of the teaching force of the many institutions which adopt this system, in a daily effort to weigh with minutest accuracy the fidelity with which assigned tasks have been committed to *memory!* The most diverse views may be entertained as to whether the college course can embrace analytical mechanics, or the theory of determinants (now so universally used), or whether it can omit vector and quaternion analysis. When, however, it is known that in a small western college graduating less than a dozen annually, we have now had for years volunteer classes, pursuing all these and other subjects annually, with success, the possibility of including them in a college curriculum must be acknowledged.

In conclusion, Professor Eddy wished to call for reform in our mathematical teaching. Let it not be so conducted that he who has neither taste for the study, nor special knowledge of it, stands on an equal footing as a teacher with the man of real mathematical insight. Now is a favorable time for revising our estimates of what can and ought to be done in this field. Higher mathematical culture has commenced a new and fruitful growth in this country in various places; and an association of the mathematicians of this country might be of service for the purpose of concerted action in improving the mathematical training in our colleges.

WHAT IS ELECTRICITY?[1]

ALL Professor Trowbridge hoped to do was to make his audience ask themselves the question with more humility and a greater consciousness of ignorance. We shall probably never know what electricity is, any more than we shall know what energy is. What we shall be able, probably, to discover, is the relationship between electricity, magnetism, light, heat, gravitation, and the attracting force which manifests itself in chemical changes. Fifty years ago scientific men attached a force to every phenomenon of nature: thus there were the forces of electricity and magnetism, the vital forces, and the chemical forces. Now we have become so far unitarian in our scientific views, that we accept treatises on mechanics which have the one word 'Dynamik' for a title; and we look for a treatise on physics which shall be entitled 'Mechanical philosophy,' in which all the phenomena of radiant energy, together with the phenomena of energy which we entitle electricity and magnetism, shall be discussed from the point of view of mechanics. What we are to have in the future is a treatise which will show the mechanical relation of gravitation, of so-called chemical attracting force, and electrical attracting force, and the manifestations of what we call radiant energy. We have reduced our knowledge of electricity and magnetism to what may be called a mechanical system, so that in a large number of cases we can calculate beforehand what will take place, and we are under no necessity of trying actual experiments. It is probable, for instance, that the correct form of a dynamo-machine for providing the electric light can be calculated and the plans drawn with as much certainty as the diagrams of a steam-engine are constructed. We may congratulate ourselves, therefore, in having a large amount of systematic knowledge in electricity: and we see clearly how to increase this systematic knowledge; for we have discovered that a man cannot expect to master the subject of electricity who has not made himself familiar with thermo-dynamics, with analytical mechanics, and with all the topics now embraced under the comprehensive title of 'physics.'

Out of all the theories of electricity, the two-fluid theories, the one-fluid or Franklin theory, and the various molecular theories, not one remains to-day under the guidance of which we are ready to march onward. We have discovered that we cannot speak of the velocity of electricity. All that we can truly say is, we have a healthy distrust of our theories, and an abiding faith in the doctrine of the conservation of energy.

It is one thing to become familiar with all the applications of the mechanical theory of electricity, and another to make an advance in the subject so that we can see the relations of electrical and magnetic attraction to the attraction of gravitation and to what we call chemical attraction. To this possible relationship, Professor Trowbridge wished to call attention. The new advances in our knowledge of electrical manifestations are to come from the true conception of the universality of electrical manifestations, and from the advance in the study of molecular physics. When we let an acid fall from the surface of a metal, the metal takes one state of electrification and the drop of acid the other: in other words, we produce a difference of electrical potential. On the other hand, a difference of electrical potential modifies the aggregation of molecules. The experiments of Lippman are well known. He has constructed an electrometer and even a dynamo-electric machine which depend upon the principle that the superficial energy of a surface of mercury covered with acidulated water is modified when a difference of electrical potential is produced at the limiting surfaces. The manifestations of what is called superficial energy, — that is, the energy manifested at the surface of separation of any two substances, — and the effect of electricity upon the superficial energy, afford much food for thought. There have always been two parties in electricity, — one which maintains that electricity is due to the contact of dissimilar substances, and the other party which believes that the source of electrical action must be sought in chemical action. Thus, according to one party, the action of an ordinary voltaic cell is due to the contact, for instance, of zinc with copper; the acid or solution of the cell merely acting as the connecting

[1] Abstract of an address before the section of physics of the American association for the advancement of science, at Philadelphia, Sept. 4, by Prof. JOHN TROWBRIDGE of Harvard college, Cambridge, vice-president of the section.

link between the two. According to the other party, it is to the difference of the chemical action of the metals on the connecting liquid, that we must attribute the rise and continuance of the electrical current. The electromotive force of a voltaic cell is undoubtedly due to the intrinsic superficial manifestation of energy when two dissimilar metals are placed in connection with each other either directly or through the medium of a conducting liquid. The chemical action of the liquid brings new surfaces of the metals constantly in contact; moreover, we have the difference of superficial energy between the liquid and the metals, so that our expression for electromotive force is far from being a simple one: it contains the sum of several modifications of superficial energy at the surfaces of the two metals and at the two boundaries of the liquid and the metals.

We have again a development of electromotive force by the mere contact of the metals at different temperatures. The electrical current that arises is due to the difference of superficial energy manifested at the surface of the two junctions. We know that the action is on the surface, for the size of the junctions does not affect the electromotive force. Suppose that we should make the metals so thin that an ultimate molecule of iron should rest against an ultimate molecule of copper, should we not arrive at a limit, at a definite temperature of the conversion of molecular vibration into electrical energy? And also, when our theory is perfected of the number of molecules along a linear line of copper against a linear line of zinc which can produce a current of electricity of a given strength, — the jostling, so to speak, of these ultimate molecules of two metals at different temperatures might form a scientific unit of electromotive force in the future science of physical chemistry. By means of an alloy we can apparently modify the superficial energy at the surface of a solid. Thus an alloy with a parent metal will give a varying electromotive force. If we could be sure that an alloy was always of a definite chemical composition, and not a more or less mechanical admixture, it seems as if we could get closer to the seat of electromotive force by a number of quantitative measurements. Unfortunately, the physical nature of alloys is not definitely known, and there is little coherence or regularity in our measurements of their electromotive force. We can modify the superficial energy of metals, not only by melting metals together, but also by grinding them to a very fine powder, and compressing them again by powerful means into solids more or less elastic, and then examining their superficial energy which is manifested as electromotive force. Professor Trowbridge is still engaged upon researches of this nature; and, if the work is not brilliant, he hopes that it will result in the accumulation of data for future generalization.

The subject of thermo-electricity has been eclipsed by the magnificent development of the dynamo-electric machines; but we may return to thermo-electricity as a practical source of electricity. Professor Trowbridge has been lately occupied in endeavoring to modify the difference of potential of thermo-electric junctions by raising one junction to a very high temperature under great pressure; for it is well known that the melting-point of metals is raised by great pressure. If the metal still remains in the solid state under great temperature and great pressure, can we not greatly increase the electromotive force which results from the difference of superficial energy manifested at the two junctions?

It is evident that our knowledge of electricity will increase with our knowledge of molecular action, and our knowledge of molecular action with that which we call attractive force. It is somewhat strange, that, although we are so curious in regard to electricity, we seldom reflect that gravitation is as great a mystery as electrical attraction. What is the relation between electricity and magnetism and gravitation and what we call the chemical force of attraction?

The question of the connection between electricity and gravitation dwelt much in Faraday's thoughts. He failed, however, to find the slightest relation between gravitation and electricity; and he closes his account of his experiments with these words: "Here end my experiments on this subject for the present, but I feel the conviction that there must be some connection between electricity and gravitation." Was the direction in which he experimented the true direction to look for a possible relation? and cannot the refined instruments and methods of the electrical science of the present aid us in more promising lines of research? If we could prove that whenever we disturb the relative position of bodies, or break up the state of aggregation of particles, we create difference of electrical potential; and, moreover, if we could discover that the work that this electrical potential can perform, together with the heat that it developed by the process, is the complete work that is done on the system against attractive force, or as so-called chemical attractive force, — we should greatly extend our vision of the relation of natural phenomena. And thus pursuing the line of argument of his address, Professor Trowbridge ventured to state an hypothetical law which it seemed to him is at least plausible: That "whenever the force of attraction between masses or molecules is modified in any way, a difference of electrical potential results." Is it not reasonable to suppose that certain anomalies which we now find in the determinations of specific heats of complicated aggregation of molecules are due to our failure to estimate the electrical equivalent of the movements and interchanges of the molecules? Let us take the case of friction between two pieces of wood: is it not possible that the friction is the electrical attraction which results from the endeavor to connect the phenomenon of superficial energy with electrical manifestations, that the friction between two surfaces is modified by keeping these surfaces at a difference of electrical potential? In Edison's motophone, we see this exemplified in a very striking manner.

Professor Trowbridge's own studies have been chiefly in the direction of thermo-electricity and in the subject of the electrical aspect of what we call superficial energy. These experiments so far deepen the belief that any change in the state of aggregation of

particles, — in other words, any change which results in a modification of attracting force, — whether gravitative or the commonly called chemical attracting forces, results in an electrical potential; and conversely, that the passage of electricity through any medium produces a change of aggregation of the molecules and atoms. If we suppose that radiant energy is electro-magnetic, cannot we suppose that it is absorbed more readily by some bodies than by others, or, in other words, that its energy is transferred, so that with the proper sense we would perceive what might be called electrical color, or, in other words, have an evidence of transformations of radiant energy other than that which appeals to us as light and color? We have arrived at the point in our study of electricity where our instruments are too coarse to enable us to extend our investigations. Is not the physicist of the future to have instruments delicate enough to measure the heat equivalent of the red and the yellow and the blue violet rays of energy? instruments delicate enough to discover beats of light as we now discover those of sound? The photographer of to-day speaks in common language of handicapping molecules by mixing gums with his bromide of silver, in order that their rate of vibration may be affected by the long waves of energy. Shall we not have the means of obtaining the mechanical equivalent of such handicapped vibrations? We have advanced; but we have not answered the question which filled the mind of Franklin, and which fills men's minds to-day: What is electricity?

CHEMICAL AFFINITY.[1]

PROFESSOR LANGLEY first reviewed the history of chemical theory, and called attention to the final extinction of the term 'affinity' in the chemical literature of the present day.

Shortly after the opening years of the present century, three general methods were indicated for the study of the force of affinity. Instead of being successively taken up and abandoned, like all preceding speculations, they have remained steadily in use during the eighty years which have intervened, and to-day they are still the most promising means at our disposal. These three methods may be called the thermal, the electrical, and the method of time or speed. It will be convenient to consider each one separately.

The most important generalization to be drawn from thermo-chemical phenomena is, that the work of chemical combination, or the total energy involved in any reaction, is very largely influenced by the surrounding conditions of temperature, pressure, and volume; and the conclusion they force upon us in regard to the nature of affinity is most important, namely, that this force in accomplishing work is dependent, like all other forces, on the conditions exterior to the reacting system which limit the possible amount of change. Affinity is therefore at last definitely removed from the category of those mystical agents, so often imagined by our predecessors in a less critical age, which had no correlation with the general forces of nature.

Under the title 'dissociation,' St. Claire Deville gave to the chemical world, in 1857, a new and fruitful method of investigating the nature of compounds by determining the temperature at which bodies break up or are dissociated. The laws developed by Deville and his successors in this field show us, that, after the point is reached at which decomposition commences, the further breaking up is determined by the pressure of the evolved products of the reaction, so that the permanence of the body depends on the magnitude of two variables, pressure and temperature, either of which may be varied at will through a wide range.

The electrical method of dissecting chemical forces has been followed less actively than the thermal one. Besides the well-known experimental contributions of Davy, Becquerel, and Faraday, may be mentioned Joule's researches on the heat absorbed during electrolysis, and especially the work of C. R. Adler Wright, on the 'determination of affinity as electromotive force.' The general outcome of these researches is, that the products of electrolysis are so numerous, and so varied by the results of secondary actions, that it is very doubtful whether the electromotive force measured is that due solely to the union of those atoms which are indicated by the principal equation of the reaction.

The method of time or speed of chemical reactions has a history as old as that of its two associates; but the story is much less eventful, for very little work has been done in this field. The most notable work has been done by Gladstone and Tribe, by ascertaining the rate at which a metallic plate could precipitate another metal from a solution.

To these general methods for studying the problems of chemical dynamics, should be added the investigation of the action of mass, by Gladstone, in his well-known color work on the sulphocyanide of iron; of the chemical action of light, by the late J. W. Draper in this country, and Prof. H. E. Roscoe in England, as well as Becquerel in France, — pioneers who have since been followed by a host of students of scientific photography.

In the review just given, no attempt has been made to do more than glance at the important contributions to the theory and methods of measuring affinity. Many names have been passed by, and much work has been necessarily ignored.

The history of the various modifications and additions which have been made to the primitive conception of the nature of affinity, when briefly summarized, appears to be this: Hippocrates held that union is caused by a kinship, either secret or apparent, between different substances. Boerhaave believed affinity to be a *force* which unites unlike substances. Bergman and Geoffroy taught that union is caused by a selective attraction; and therefore they called it 'elective affinity.' Wenzel and his success-

[1] Abstract of an address to the section of chemistry of the American association for the advancement of science, at Philadelphia, Sept. 4, by Prof. J. W. LANGLEY, of the University of Michigan, Ann Arbor, Mich., vice-president of the section.

ors showed that affinity is definite in action and amount: it has limits, or proceeds *per saltum*. Berthollet contended that affinity is not definite: he proves that it is often controlled by the nature and the masses of the reacting bodies. Dalton, Berzelius, Wollaston, and others held, on the contrary, this force to be definite, and to act *per saltum*: it is a power which emanates from the atom. Davy, Ampère, and Berzelius believed affinity to be a consequence of electrical action. Avogadro in one way, and Brodie in another, show us affinity exerted by molecules as well as atoms. It is a force which binds together, not only particles of the same substance, but also of heterogeneous substances. From the fact of the actual existence of radicles, and from the phenomena of substitution, was developed the notion of position, and that, therefore, affinity varied with the structure of the body as well as with its composition. The differences between the number of atoms which are equal to hydrogen in replacing power have led to the doctrine of valence, which, if it has any influence on theories of affinity, shows that this property of matter has two distinct concepts, — one, its power of attracting a number of atoms; the other, its power of doing work or evolving energy. These two attributes seem to be in no way related to each other. Mendelejeff and Lothan Meyer have shown, by the facts which are grouped under the title 'periodic law,' that the properties of elements seem to be repeating functions of the atomic weight. Hence affinity is connected in some way with that same property, which is also shown by the differential action of gravitation on the absolute chemical unit of matter. Finally, Williamson, Kekulé, and Michaelis have suggested that combination is brought about and maintained by incessant atomic interchange; hence, that affinity is fundamentally due to some form of vibration.

The idea which seemed so simple and natural a one to Hippocrates has grown successively more complex and less sharply defined; and we are compelled to admit that the years have not brought the theory of affinity to a state of active growth. Chemists have more and more turned their attention to details, to accumulating methods of analysis and synthesis, to questions of the constitution of salts, to discussions about graphic and structural formulae, and to hypotheses about the number and arrangement of atoms in a molecule; but they have not, until quite recently, made systematic attempts to measure the energies involved in reactions. Why? The answer can be found mainly in two reasons. First, the word 'affinity' is in bad odor. We see how enormously complicated the phenomena of chemical action have become, and we have lost all faith in hypotheses which can be evolved by the mere force of metaphysical introspection. Second, there is a more important reason, arising from what has hitherto been the traditional scope of our science. Chemistry alone of the physical sciences has offered no foothold to mathematics; and yet all her transformations are governed by the numbers which we call 'atomic weights.' What is it which causes chemistry, so preeminently the analytic science of material things, to be the only one which does not invite the aid of mathematics? It is because three fundamental conceptions underlie physics, while only two serve the needs of the chemist. If a term so much used just now by transcendental geometers may be borrowed, one would say that physics is a science of three dimensions, while chemistry is a science of two dimensions. In the first, nearly every transformation is followed by its equation of energy; and this involves the concepts space, mass, time: while, in the second, an ordinary chemical equation gives us the changes of matter in terms of space and mass only; that is to say, in units of atomic weight and atomic volume.

Think for a moment what physics would be to-day without those grand generalizations, Newton's theory of gravitation, Young's undulatory theory of light, the dynamic theory of heat, the kinetic theory of gases, the conservation of energy, and Ohm's law in electricity. Every one of these, except the last, is a dynamic hypothesis, and involves velocity — that is, time — as one of its essential parts. In comparison with the above, all ordinary chemical work may be termed the registration of successive static states of matter. The analyst pulls to pieces, the synthetic chemist builds up; each records his work as so many atoms transferred from one condition to another, and he is satisfied to exhibit the body produced quietly resting in the bottom of a beaker, motionless, static. The electrolytic cell tells us the stress of chemism for specified conditions as electromotive force; the splendid work done in thermo-chemistry enables us to know the whole energy involved when A unites with B, or when A B goes through any transformation however intricate, but it does not inform us of the dynamic equation which accompanies them, and which should account for the interval between the static states.

Whenever we look outside of chemistry, we find that the lines of the great theories along which progress is making are those of dynamic hypotheses. If we go to our biological brethren, we see them too moving with the current; the geologist studies upheavals, denudation, rate of subsidence, glacial action, and all kinds of changes, in reference to their velocity; the physiologist is actively registering the time element in vital phenomena, through the rate of nervous transmission, the rate of muscular contraction, the duration of optical and auditory impressions, etc.; even the sociologist is beginning to hint at velocities, as, indeed, we should expect in a student of revolutions; and we cannot ignore the fact that all the great living theories of the present contain the time element as an essential part. The speaker could but think the reason that chemistry has evolved no great dynamical theory, that the word 'affinity' has disappeared from our books, and that we go on accumulating facts in all directions but one, and fail to draw any large generalization which shall include them all, is just because we have made so little use of the fundamental concept, time. To expect to draw a theory of chemical phenomena from the study of

electrical decompositions and of thermo-chemical data, or from even millions of the customary static chemical equations, would be like hoping to learn the nature of gravitation by laboriously weighing every moving object on the earth's surface, and recording the foot-pounds of energy given out when it fell. The simplest quantitative measure of gravity is, as every one knows, to determine it as the acceleration of a velocity: when we know the value of g, we are forever relieved, in the problem of falling bodies, from the necessity of weighing heterogeneous objects at the earth's surface, for they will all experience the same acceleration. May there not be something like this grand simplification to be discovered for chemical changes also?

The study of the speed of reaction has but just begun. It is a line of work surrounded with unusual difficulties, but it contains a rich store of promise. All other means for measuring the energies of chemism seem to have been tried except this: is it not, therefore, an encouraging fact, that to the chemists of the nineteenth century is left for exploration the great fruitful field of the true dynamics of the atom, the discovery of a time rate for the attractions due to affinity?

THE MISSION OF SCIENCE.[1]

AFTER thanking the section for the honor conferred upon him by electing him their chairman, and referring to the success of the meeting of the British association at Montreal, Professor Thurston announced as the subject of his address, 'The mission of science.' He spoke of his address, as vice-president at St. Louis in 1878, on the philosophic method of the advancement of science, in which he had called attention to the need of specialists, amply supplied with the proper means, to do the work of observing, collecting, and co-ordinating the results of observation. As an all-important factor in this the modern system of scientific investigation, he had spoken of the men who have given, and who are still generously and liberally giving, material assistance by their splendid contributions to the scientific departments of our colleges and of our technical schools.

It may well be asked, What is the use, and what is the object, of systematically gathering knowledge, and of constructing a great, an elaborate system, having the promotion of science as its sole end and aim? What is THE MISSION OF SCIENCE? The great fact that material prosperity is the fruit of science, and that other great truth, that, as mankind is given opportunity for meditation and for culture, the higher attributes of human character are given development, are the best indications of the nature of the real mission of science, and of the correctness of the conclusion that the use and the aim of scientific inquiry are to be sought in the region beyond and above the material world to which those studies are confined.

It being granted that the mission of science is the amelioration of man's condition, it becomes of importance to consider the way in which our knowledge is increased. While the scientific method of advancement of science is evidently that which will yield the greatest returns, it is not the fact that we are indebted to such philosophic methods for the production of the modern sciences. The inventor of gunpowder lived before Lavoisier; the mariner's compass pointed the seaman to the pole before magnetism took form as a science; the steam-engine was invented and set at work, substantially in all essential details as we know it to-day, before a science of thermo-dynamics was dreamed of.

But all this is of the past. Science has attained a development, a stature, and a power, that give her the ability to assume her place in the great scheme of civilization. Hereafter she will direct and will lead. The blind, scheming ways of the older inventor will give place to the exact determination, by scientific methods, of the most direct and most efficient way of reaching a defined end, — methods now daily practised by the engineer in designing his machinery.

It is only in modern times, and since the old spirit of contempt for art, and of reverence for the non-utilitarian element in science, has become nearly extinguished, and since our systems of education have begun to include the study of physical science, that we have had what is properly called a division of 'applied science.' In the days of classical learning, science was only valued as it developed a system of purely intellectual gymnastics. Archimedes was the most perfect prototype, in those days, of the modern physicist and mechanician, of the scientific man and engineer; yet he, and all his contemporaries, esteemed his discovery of the relation between the volumes of the cylinder and the sphere more highly than that of the method of determining the specific gravity of a solid, or the composition of an alloy, and deemed the quadrature of the parabola a greater achievement than the theory of the lever which might 'move the world.' His enumeration of the sands of the seashore was looked upon as a nobler accomplishment than the invention of the catapult, or of the pump, which, twenty-one centuries after his death, still bears his name.

No system of applied science could exist among people who had no conception of the true mission of science; and it was not until many centuries had passed, that mankind reached such a position, in their slow progress toward a real civilization, that it became possible to effect that union of science and the arts which is the distinguishing characteristic of the age in which we live.

In illustration of the gradual evolution and growth of correct theory, and of this slow development of rational views, of the methods of scientific deduction, and of the invariably tardy progress from a beginning distinguished by defective knowledge and inaccurate logic, in the presence of what are later seen to be

[1] Abstract of an address to the section of mechanical science of the American association for the advancement of science at Philadelphia, Sept. 4, by Prof. R. H. THURSTON of Stevens institute, Hoboken, N.J., vice-president of the section.

plainly visible facts, and of what ultimately seem obvious principles, observe the rise and progress of our hardly yet completed theory of that greatest of human inventions, the steam-engine.

Studying the history of the development of this theory, it cannot fail to become strikingly evident that, throughout, experimental knowledge and practical construction have been constantly in advance of the theory; and that the science of the conversion of heat-energy into mechanical power has, in all stages of this progress, come in simply to confirm general conclusions, previously reached by deduction from experience and observation, to give the reasons for well-ascertained facts and phenomena, and often — not always promptly or exactly — to define the line of improvement, and the limitations of such advance.

The theory itself began by the correlation of the facts determined by the experiments of Rumford and Davy at the beginning of the century, those announced by Joule and Thomson many years later, and the laws developed by Clausius, Rankine, and Thomson, at the middle of the century. But Watt had discovered, a hundred years ago, the facts which have since been found to set limits to the efficiency of the engine. Smeaton, in many respects the greatest mechanical engineer of his time, made practically useful application of the knowledge so acquired, and endeavored to secure immunity from these wastes by thoroughly philosophical methods. Clarke, a generation ago, showed how the losses first detected by Watt set a definite limit, under the conditions of familiar practice, to the gain to be secured by the expansion of steam; and Cotterill, within a few years, has shown, by beautiful methods of treatment, their magnitude, and how these wastes take place. Hirn and Leloutre, in France, have similarly thrown light upon the phenomena of 'cylinder condensation,' and De Freminville has suggested the method of remedy. Yet it is only now that we are beginning to see that the philosophy of heat-engines is not simply a thermodynamic theory, and that it involves problems in physics, and a study of the methods of conduction and transfer of heat, without doing work from point to point in the engine. We are only now learning how to apply the knowledge gained by Isherwood twenty years ago, and by Hirn and by Clarke still earlier, in solving the problem of maximum efficiency of the steam-engine. We have only now discovered that the 'curve of efficiency,' as Prof. Thurston has called it, is not the curve of mean pressure for 'adiabatic' expansion, as Rankine called it; for 'isentropic' expansion, as Clausius would call it; but that it is a curve of very different form and location, and that it is variable with every physical condition affecting the working of the expanding fluid in the engine. We have only now learned that every heat-engine has a certain 'ratio of expansion for maximum efficiency,' which marks the limit to gain in economy by expansion; which limit is fixed for each engine by the nature of the expansion, and the method and extent of wastes of heat. All the facts of this case were apparently as obvious, as easily detected and weighed in their influence upon the theory of heat-engines, years ago as to-day. Even the latest phase of the current discussion of efficiencies of heat-engines, that relating to their commercial efficiency, would seem to have been as ready for development a generation ago, when first noted by Rankine, as to-day; yet what is now known as a simple and easily formulated theory has been several decades in growing into shape, notwithstanding that all the needed facts were known, or readily determinable, at the very beginning of the period marked by its evolution. It is only within a year or two that it has become possible to say that the theory of the steam-engine, as a case in applied mechanics, has become so complete that the engineer can safely rest upon it in the preparation of his designs, and in his calculations of power, economy, and commercial efficiency.

Professor Thurston then referred to the knowledge now being collected as to the strength, elasticity, and enduring capacity of the materials used in construction. But the slow progress of scientific development in matters relating to common practice in the useful arts is hardly less remarkable than the difficulty with which scientific principles, even when well established and well known among scientific and educated men, sink down into the minds of the masses. Perhaps no principle in the whole range of physical science is better established and more generally recognized than that which asserts the maximum efficiency of fluid in heat-engines to be a function simply of the temperatures of reception and rejection of heat, and to be absolutely independent of the nature of the working-fluid.

This was shown by Carnot sixty years ago, and has been considered one of the fundamental principles of thermo-dynamics from that time to this. Nevertheless, so rarely is it comprehended by mechanics, and so difficult is it for the average mind to accept this truth, that the most magnificent fallacies of the time are based upon assumptions in direct contradiction of it. The various new 'motors' recently brought before the public with the claim of more than possible perfection have taken hundreds of thousands of dollars, within the past two or three years, from the pockets of credulous and greedy victims. It is not sufficient to declare the principle: the comparison of steam with ether, and of air or gas with carbon-disulphide or chloroform, must be made directly, and the results presented in exact figures, before the unfortunate investor, whose rapaciousness is too often such as to cause him to give ear to the swindler rather than to the well-informed and disinterested professional to whom he would ordinarily at once go for advice, can be induced to withdraw from the dangerous but seductive scheme. It is true that the principle does not as exactly apply to a comparison of efficiencies of machine, and that the vender of new motors usually seizes upon this point as his vantage-ground; but a careful comparison of the several fluids, both as to efficiency of fluid and efficiency of machine, throughout the whole range of temperatures and pressures found practicable in application, such as has recently

been made under Prof. Thurston's direction, shows that the final deduction is substantially the same for all the usually attainable conditions of practice, and further, that, of all the available fluids, steam is fortunately the best.

That the results of scientific investigation may be the more readily appreciated, it is necessary that the study of physical science should be more thorough in our schools. The stereotyped argument for the retention of the old system of education to the exclusion of the new, was, and is to-day, the assertion that the old system strengthened the intellect and broadened the views of the student, while the new subjects are *merely useful*; but the wisdom and the expediency of a modification of old ways, in this respect, is now rapidly becoming acknowledged, and the new education may be considered as fairly and safely introduced. Science will never, we may be sure, displace entirely the older departments of education: but science will henceforth take a place beside them as no less valuable for mental discipline.

With science recognized as a respectable companion of the dead languages, we shall have better trained students, — students who will be better able to lead in the industries, and so aid material prosperity. As it is the duty of government to so regulate affairs that each man may have the power of improving his condition to the utmost, so will it be the duty of science to point out to government how it may direct its regulations to the greatest advantage of the individual. Men of science, each in his own department, are the natural advisers of the legislator. Citizens and legislators are both entitled to claim this aid from those who have made the sciences of the several arts their special study, and from those who have devoted their lives to the study of the sciences of government, of social economy, and of ethics.

Of all the many fields in which the men of science of our day are working, that which most nearly concerns us, and that which is of most essential importance to the people of our time, is that department of applied science which is most closely related to the industries of the world, — mechanics. The development of new industries becomes as much a part of the work of science in the future as is the improvement of those now existing. The new industries must evidently be mainly skilled industries, and must afford employment to the more intelligent and more finely endowed of those to whom our modern systems of education are offering their best gifts. The enormous advancement of the intellectual side of life must inevitably, it would seem, result in the production of a race of men peculiarly adapted to such environment as science is rapidly producing. Thus accomplishing, under the guidance of science, such tasks as lie before him to accomplish, the 'coming man,' with his greater frontal development, his increased mental and nerve power, his growing endurance and probably lengthening life, will be the greatest of the products of this scientific development, and the noblest of all these wonderful works.

THE CRYSTALLINE ROCKS OF THE NORTH-WEST.[1]

UNTIL very recently, it has been the practice of geologists, almost without exception, to refer every crystalline rock in the north-west either to the Huronian or to the Laurentian. But when, on more careful examination, it is found that this nomenclature is imperfect, we are thrown into much difficulty and doubt. In order that some of the difficulties of the situation may be made clear, Professor Winchell proposed to review concisely the broad stratigraphic distinctions of the crystalline rocks that have lately been studied in Michigan, Wisconsin, and Minnesota.

Omitting the igneous rocks, which in the form of dikes cut through the shales and sandstones of the cupriferous formation, and are interbedded with them in the form of overflows, we may concisely arrange the crystalline rocks, disregarding minor differences and collating only the broad stratigraphic distinctions, in the following manner, in descending order: 1°. Granite and gneiss with gabbro; its thickness is unknown, but certainly reaches several hundred feet. 2°. Mica schist: maximum thickness, five thousand feet. 3°. Carbonaceous and arenaceous black slates, and black mica schists; thickness, twenty-six hundred feet. 4°. Hydro-mica and magnesian schists; maximum thickness, forty-four hundred and fifty feet. 5°. Quartzite and marble: normal thickness, from four hundred to a thousand feet. 6°. Granite and syenite with hornblendic schists; thickness unknown, but very great.

These six great groups compose, so far as can be stated now, the crystalline rocks of the north-west. Their geographic relations to the non-crystalline rocks, if not their stratigraphic, have been so well ascertained that it can be stated confidently that they are all older than the cupriferous series of Lake Superior, and hence do not consist of, nor include, metamorphosed sediments of Silurian, or any other age. The term 'Silurian' here is understood to cover nothing below the base of the Trenton.

Examining these groups more closely, we find: 1°. We have, beneath the red tilted shales and sandstones, a great granite and gabbro group. The gabbro is certainly eruptive, but the associated granite and gneiss are probably metamorphic. The gabbro does not always appear where the granite is present; but in other places these rocks are intricately mingled, although the gabbro can be considered in general as the underlying formation. 2°. Below this granite and gabbro group is a series of strata that may be designated by the general term 'mica schist group.' This division is penetrated by veins and masses of red biotite-granite, which appear to be intrusive in somewhat the same manner as the red granite in the gabbro. These granite veins penetrate only through the overlying gabbro and this underlying mica schist.

[1] Abstract of an address to the section of geology and geography of the American association for the advancement of science at Philadelphia, Sept. 4, by Prof. N. H. WINCHELL of the University of Minnesota, Minneapolis, Minn., vice-president of the section.

They are wanting or comparatively rare throughout the rest of the crystalline rocks. 3°. The next lower grand division might be styled the 'black mica slate group.' This group contains much carbon, causing it to take the form of graphitic schists, in which the carbon sometimes amounts to over forty per cent. These schists are frequently quartzose and also ferruginous. Associated with these black mica slates, which often appear also as dark clay-slates, are actinolitic schists; the whole being, in some places, interstratified with diorite. 4°. Underneath this is a very thick series of obscure hydro-micaceous and greenish magnesian schists, in which, along with gray quartzite and clay slates, occur the most important deposits of hematitic iron-ore. This division of the crystalline rocks has numerous heavy beds of diorite. 5°. Below this series of soft schists is the great quartzite and marble group. The marble lies above the quartzite, and in the Menominee region has a minimum thickness of at least a thousand feet. This is a most persistent and well-marked horizon. In northern Minnesota, the great slate-conglomerate of Ogishke Muncie Lake, with a thickness exceeding six thousand feet, seems to represent the lower portion of the great quartzite of this group, and to be the equivalent of the lower slate-conglomerate of the 'typical Huronian' in Canada.

Now, the difficulties of the situation arise when we cast about to find names for these parts. What are the eastern representatives of these western groups, and by what designations shall they be known?

We meet, at the outset, with the question, Is there a formation such as claimed by Emmons, — the Taconic? On this geologists are yet divided. Having given the subject very careful consideration, Professor Winchell was ready to state his very positive conviction that Dr. Emmons was essentially right, and that the Taconic group will have to be recognized by geologists, and adopted in the literature of American geology.

In the first presentation of the Taconic system, Dr. Emmons extended it geographically too far east, and unfortunately chose a name for it which is appropriate only to a part of that eastward extension. Dr. Emmons's claim, however, in all its essential points, remains intact. This consists in the existence of a series of sedimentary deposits, largely metamorphic, below the Potsdam sandstone, and separating the Potsdam from the crystalline rocks known as 'primary' in an orderly chronological scheme. It is not necessary to refer to the controversies that arose from the creation of the imaginary Quebec group, nor to characterize in deserved terms the attempt to bury the Taconic in the Quebec coffin.

There may be reasons why the current literature of American geology is almost silent respecting the great work of Emmons, and why the Taconic is not known among the recognized geological formations. But we have nothing to do with these at this time. We have now only to say, that it seems necessary to admit, that when Dr. Emmons insisted on a great group of strata belonging to the age of the lower Cambrian, lying below the Potsdam sand-rock in New York, he had some foundation more substantial than imagination or mere hypothesis.

If we examine the descriptions given by Dr. Emmons of his Taconic system, we shall find that he makes the following broad stratigraphic distinctions: 1°. His highest member is what he designates 'black slate,' which he declares, in some cases plunges apparently beneath the 'ancient gneiss,' and contains a considerable amount of carbonaceous matter. 2°. Under the black slate his next grand distinction was the so-called Taconic slate, which he described as argillaceous, siliceous, and 'talcose;' thickness about two thousand feet. 3°. Below the great mass of soft schists, he described a mass of five hundred feet of limestone, designated 'Stockbridge limestone,' which graduates downward into 'talcose' or magnesian sandstones and slates; the whole having a thickness of about seventeen hundred feet. 4°. Under this limestone is his 'granular quartz' rock, more or less interstratified with slates, and becoming, in some places, an immense conglomerate with a 'chloritic paste.' 5°. The 'ancient gneiss,' on which the Taconic system was said to lie unconformably.

Now, it requires but a glance to perceive how clearly this order coincides with that which has been independently and laboriously worked out in the north-west. We have in both instances a 'black slate,' and below this in both cases is an immense series of soft hydro-mica and magnesian schists. These, again, are followed by crystalline limestone, or marble, which changes downwards to slate, and a hard sand-rock. Below this is the great bed of quartzite; which is, at the base, coarsely conglomeritic with masses of rock from the great underlying series of gneiss.

We are now, however, confronted with another difficulty. The geologists of Michigan and Wisconsin have set aside Dr. Emmons's identification of the Menominee rocks with the Taconic, in 1846, and have called them Huronian. It becomes necessary, therefore, to ascertain of what the Huronian system consists.

The 18,000 feet of the Huronian system on the shores of Lake Huron include 900 feet of limestone, 2,000 feet of 'chloritic and epidotic slates,' and 15,100 feet of quartzite and conglomerate. Perhaps 5,000 feet of this thickness may be considered intrusial. This will leave 12,000 feet, at least, for the aggregate thickness of quartzite and conglomerate, being nearly double that observed in the same horizon in northern Minnesota. It is plain to see, that, if there be any parallelism between these beds and the various groups made out in the north-west, the whole of these strata must be made the equivalent of group 5, or the quartzite and marble group.

There is, therefore, a conflict between the Taconic and the Huronian, both in respect to the horizon which they are intended to cover, and in the horizon of rocks which they actually compass. The Huronian, however, in its original and typical description, can be parallelized with only the very lowest of the strata that were included in the typical and original Taconic; while the Taconic stretches upward at least as far as to include the fourth and third grand

groups made out in the north-west; that is to say, the hydro-mica and magnesian schists, and the carbonaceous and arenaceous black slates.

This leaves two series of rocks untouched by the scope of either the Huronian or the Taconic, as these systems were at first defined; namely, the mica-schist group, and the granite and gneiss with gabbro group. In the term 'Montalban,' proposed for these groups by Dr. Hunt, the two are united; and the constant distinctness which they seem to maintain is not recognized. The granite and gabbro group has affinities with the overlying cupriferous rocks, and perhaps, as Irving has suggested, should be considered the base of that series; whereas the mica-schist group has, without exception, been assigned to the same system and age as the underlying groups. The granite and gabbro group has likewise been designated differently. The gabbro has been called Laurentian, Labradorian, and Norian; and the granite and gneiss have received, under one of their modified conditions, the special designation Arvonian. Professor Winchell thought he had already shown that the Arvonian rocks are interstratified with the cupriferous, and are modified sediments of that series. Instead of being near the bottom of the 'Huronian' in the north-west, they overlie all the groups that have been assigned to the Huronian by Irving, and constitute a part of the great series of younger gneisses, which by Brooks has been marked as the 'youngest Huronian.'

It is evident, that at present it is an impossible undertaking, to assign the groups of the crystalline rocks of the north-west to any of the terranes that have been named farther east, without violating somebody's system of nomenclature. Respecting the horizon known as 'Laurentian,' there is an approach to unanimity and agreement. This, however, consists more in a tacit consent to style the lowest known rocks Laurentian, than in any agreement among geologists as to the nature and composition of the strata. The Taconic of Emmons has been generally ignored. The original Huronian has grown from the dimensions of a single group (the quartzite and marble group), so as to include all the crystalline rocks lying above that group, spreading from the Laurentian to the unchanged sediments of the upper Cambrian. This has in some cases become so obviously wrong, and has included groups of rocks so plainly extra-Huronian, that a double and triple nomenclature has been applied to a part of these upper rocks. These new names, with the exception of the name Montalban, seem to be of value only as regional designations; the strata which they represent being igneous or metamorphic, and hence liable to be wanting in some places, and to be non-crystalline in others. They further complicate the stratigraphic nomenclature, since they are probably only the locally modified lower parts of the New-York system.

In conclusion, the chief points brought out in this discussion may be re-stated more concisely:

1. The crystalline rocks of the north-west are comprised under six well-marked, comprehensive groups.

2. The Taconic of Emmons, so named in 1842, and more correctly defined in 1846, included three of those groups.

3. The Huronian of Canada is the equivalent of the lowest of the Taconic groups, and the perfect parallel of only the lowest of the groups in the north-west that have been designated Huronian.

4. The uppermost of the groups in the north-west is local in its existence and exceptional in its characters, and has received, therefore, a variety of names.

5. There are, therefore, confusion and conflict of authority in the application of names to the crystalline rocks of the north-west.

CATAGENESIS; OR, CREATION BY RETROGRADE METAMORPHOSIS OF ENERGY.[1]

THE general proposition, that life has preceded organization in the order of time, may be regarded as established. It follows necessarily from the fact, that the simple forms have, with few exceptions, preceded the complex in the order of appearance on the earth. The history of the lowest and simplest animals will never be known, on account of their perishability; but it is a safe inference from what is known, that the earliest forms of life were the rhizopods, whose organization is not even cellular, and includes no organs whatever. Yet these creatures are alive; and authors familiar with them agree that they display, among their vital qualities, evidences of some degree of sensibility.

After recalling the proposition laid down years ago by Lamarck, regarding the effect on structure of the use and disuse of organs, the speaker explained kinetogenesis as the production of animal structures by animal movements; and archæstheticism as the doctrine that sensibility or consciousness has ever been one of the primary factors in the evolution of animal forms. The influence of motion on development is involved in Spencer's theory of the origin of vertebrae by strains: and the speaker maintained that the various agencies mentioned by Lamarck as producing change are simply stimuli to motion.

In the present address he proposed to pursue the question of the relation of sensibility to evolution, and to consider some of the consequences which it involves; though in the present early stage of the subject he could only point out the logical conclusions derivable from facts well established, rather than any experimental discoveries not already known. Those who object to the introduction of metaphysics into biology must consider that they cannot logically exclude the subject. As in one sense a function of nervous tissue, mind is one of the functions of the body. Its phenomena are everywhere present in the animal kingdom. It is only want of familiarity with the subject which can induce a biologist to exclude the science of mind from the field.

[1] Abstract of an address delivered before the section of biology of the American association for the advancement of science, at Philadelphia, Sept. 4, by Prof. E. D. COPE, of Philadelphia, vice-president of the section.

The hypothesis that consciousness has played a leading part in evolution would seem to be negatived by the well-known facts of reflex action, automatism, etc., where acts are often unconsciously performed, and often performed in direct opposition to present stimuli. But while it is well understood that these phenomena are functions of organized structure, it is believed that the habits which they represent were inaugurated through the immediate agency of consciousness. It is not believed that a designed act can have been performed for the first time without consciousness, on the part of the animal, of the want which the act was designed to relieve or supply. We know, that, so soon as a movement of body or mind has been acquired by repetition, consciousness need no longer accompany the act. The act is said to be automatic when performed without exertion, either consciously or unconsciously; and in those functions now removed from the influence of the unconscious mind, such acts are called reflex. The *origin* of the acts is, however, believed to have been in consciousness, not only for the reasons above stated, but also from facts of still wider application. The hypothesis of archaestheticism, then, maintains that consciousness as well as life preceded organism, and has been the *primum mobile* in the creation of organic structure. It will be possible to show that the true definition of life is, *energy directed by sensibility, or by a mechanism which has originated under the direction of sensibility.* If this be true, the two statements, that life has preceded organism, and that consciousness has preceded organism, are co-equal expressions.

Regarding, for the time being, the phenomena of life as energy primitively determined by consciousness, we may look more closely into the characteristics of this remarkable attribute. That consciousness, and therefore mind, is a property of matter, is a necessary truth, which to some minds seems difficult of acceptance. Clearly it is not one of the known so-called inorganic forces. Objects which are hot, or luminous, or sonorous, are not on that account conscious; so that consciousness is not a necessary condition of energy. On the other hand, in order to be conscious, bodies must possess a suitable temperature, and must be suitably nourished; so that energy is a necessary condition of consciousness. For this reason some thinkers erroneously regard consciousness as a form or species of energy. We all understand the absurdity of such expressions as the equivalency of force and matter, or the conversion of matter into force. They are not, however, more absurd than the corresponding proposition more frequently heard, that consciousness can be converted into energy, and *vice versa.*

The energetic side of consciousness, however, may be readily perceived. Acts performed in consciousness involve a greater expenditure of energy than the same acts unconsciously performed: the labor is directly as the consciousness involved. The dynamic character of consciousness is also shown in its exclusiveness: two opposite emotions cannot occupy the mind at the same moment of time. But there is no fact with which we are more familiar than that consciousness in some way determines the direction of the energy which it characterizes. The stimuli which affect the movements of animals at first, only produce their results by transmission through the intermediation of consciousness. Without consciousness, education, habits, and designed movements would be impossible. So far as we know, the instinct of hunger, which is at the foundation of animal being, is a state of consciousness in all animals.

On the other hand, as consciousness is an attribute of matter, it is of course subject to the laws of necessity to which matter and energy conform. It cannot cause two solid bodies to occupy the same space at the same time, make ten foot-pounds of energy out of five foot-pounds of energy, nor abolish time more than it can annihilate space.

What is, then, the immediate action of consciousness in directing energy into one channel rather than another? Why, from a purely mechanical point of view, is the adductor muscle of the right side of the horse's tail contracted to brush away the stinging fly from the right side of the horse's body, rather than the left adductor muscle? The first crude thought is, that consciousness supplies another energy which turns aside the course of the energy required to produce the muscular contraction; but consciousness, *per se*, is not itself a force (= energy). How, then, can it exercise energy?

The key to many weighty and mysterious phenomena lies in the explanation of the so-called voluntary movements of animals. The explanation can only be found in a simple acceptance of the fact, that *energy can be conscious.* If true, this is an ultimate fact, neither more nor less difficult to comprehend than the nature of energy or matter in their ultimate analyses. But how is such an hypothesis to be reconciled with the facts of nature, where consciousness plays a part so infinitesimally small? The explanation lies close at hand, and has already been referred to. *Energy become automatic is no longer conscious*, or is about to become unconscious. What the molecular conditions of consciousness are, is one of the problems of the future. One thing is certain: the organization of the mechanism of habits is its enemy. *It is clear that in animals, energy, on the loss of consciousness, undergoes a retrograde metamorphosis*, as it does later in the history of organized beings on their death. This loss of consciousness is first succeeded by the so-called involuntary and automatic functions of animals. According to the law of catagenesis, the vegetative and other vital functions of animals and plants are a later product of the retrograde metamorphosis of energy. With death, energy falls to the level of the polar tensions of chemism, and the regular and symmetrical movements of molecules in the crystallization of its inorganic products.

It has been already advanced, that the phenomena of growth-force, which are especially characteristic of living things, originated in the direction given to nutrition by consciousness and by the automatic movements derived from it. There remain, however, some other phenomena which do not yield so readily to this analysis. These are, first, the conver-

...se of the living movements in
...ght for in the intense atomic
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...f components:" the molecular
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...matter; and it is believed that the
...f all such movements are those of
...mental action, which are furthest
from molar movements. From this
..., when molar movements are derived
...movements, it is by a process of run-
...energy, not of elevation; by an increase
from mental energy, not an approxi-

...r in which protoplasm is made at the
...is highly suggestive. The first piece
...sm had, however, no paternal protoplasm
... to derive its being. The protoplasmic
... energy must, therefore, have previously
...some form of matter not protoplasm. In
...the theory of catagenesis, the plant-life is
...ve of the primitive life, and it has retained
...f the primitive quality of self-maintenance
...it from running down into forms of energy
...below the life level; that is, such as are
inorganic chemical type, or the crystalline
...type.

...then, some form of matter other than proto-
...has been capable of sustaining the essential
...of life, it remains for future research to de-
..., and to ascertain whether it has long existed
...of the earth's material substance or not. The
...of the earlier stages of our planet may have
...idden its presence, or it may not. If it were
...ided from the earth in its first stages, we may
...ognize the validity of Sir William Thomson's sug-
...stion, that the physical basis of life may have
...ached us from some other region of the cosmos by
...nsportation on a meteorite. If protoplasm in any
...rm were essential to the introduction of life on
...ur planet, this hypothesis becomes a necessary truth.

Granting the existence of living protoplasm on the earth, there is little doubt that we have some of its earliest forms still with us. From these simplest of living beings, both vegetable and animal kingdoms have been derived. But how was the distinction between the two lines of development, now so widely divergent, originally produced? The process is not difficult to imagine. The original plastid dissolved the salts of the earth, and appropriated the gases of the atmosphere, and built for itself more protoplasm. Its energy was sufficient to overcome the chemism that binds the molecules of nitrogen and hydrogen in ammonia, and of carbon and oxygen in carbonic dioxide. It apparently communicated to these molecules its own method of being, and raised the type of energy from the polar non-vital to the adaptive vital by the process. But consciousness apparently early abandoned the vegetable line. Doubtless all the energies of vegetable protoplasm soon became

automatic. The plants in general, in the persons of their protist ancestors, soon left a free-swimming life and became sessile. Their lives thus became parasitic, more automatic, and in one sense degenerate.

The animal line may have originated in this wise: Some individual protists, perhaps accidentally, devoured some of their fellows. The easy nutrition which ensued was probably pleasurable, and once enjoyed was repeated, and soon became a habit. The excess of energy thus saved from the laborious process of making protoplasm was available as the vehicle of an extended consciousness. From that day to this, consciousness has abandoned few if any members of the animal kingdom. In many of them, it has specialized into more or less mind. Organization to subserve its needs has achieved a multifarious development. Evolution of living types is, then, a succession of elevation of platforms, on which succeeding ones have built. The history of one horizon of life is that its own completion, but prepares the way for a higher one, furnishing the latter with conditions of a still farther development.

If the principles here announced be true, it is highly probable that *all forms* of energy have originated in the process of running-down or specialization from the primitive energy. One of the problems to be solved by the physicists of the present and future is that of a true genealogy of the different kinds of energy. In this connection a leading question will be the determination of the essential differences between the different forms of energy, and the material conditions which cause the metamorphosis of one kind of energy into another.

That the tendency of purely inorganic energy is to 'run down,' is well known. Inorganic chemical activity constantly tends to make simpler compounds out of the more complex, and to end in a satisfaction of affinities which cannot be farther disturbed except by access of additional energy. In the field of the physical forces, we are met by the same phenomenon of running down. All inorganic energies or modes of motion tend to be ultimately converted into heat, and heat is being steadily dissipated into space.

The process of creation by the retrograde metamorphosis of energy, or, what is the same thing, by the specialization of energy, may be called *catagenesis*. It may be denied, however, that this process results in a specialization of energy. The vital energies are often regarded as the most special, and the inorganic as the most simple. If we regard them, however, solely in the light of the essential nature of energy, i.e., power, we must see that the chemical and physical forces are most specialized. The range of each species is absolutely limited to one kind of effect, and their diversity from each other is total. How different this from the versatility of the vital energy! It seems to dominate all forms of conversion of energy, by the mechanisms which it has, by evolution, constructed. Thus, if the inorganic forces are the products of a primitive condition of energy which had the essential characteristics of vital energy, it has been by a process of specialization. As we have seen, it is this specialization which is everywhere inconsistent with life.

If we consider the relations of the different kinds of energy to each other and to consciousness, it is difficult to draw the line between conscious and unconscious states of energy. One reason is, that, although a given form of energy may be unconscious, consciousness may apprehend the action by perceiving its results. The relations may be expressed as follows:—

A. *Designed* (always molecular).	*Examples.*
I. Conscious.	
1. Involving effort	'Voluntary' acts.
2. Not involving effort	Passive perception. Conscious automatism.
II. Unconscious.	
3. Involving mental process	Unconscious automatic.
4. Not involving mental process . . .	Reflex.
B. *Not designed.*	
I. Molecular.	
5. Electric.	
6. Chemical, 7. Physical,	Crystallific and non-crystallific.
II. Molar.	
8. Cosmic.	

The only strictly molar energies of the above list are the cosmical movements of the heavenly bodies. The others are molecular, although they give rise to molar movements, as those of the muscles, of magnetism, etc. Some molar movements of organic beings are not, *in their last phases*, designed; as those produced by nervous diseases.

The transition between the organic and the inorganic energies may be possibly found in the electric group. Its influence on life, and its resemblance to nerve-force, are well known. It also compels chemical unions otherwise impracticable; thus resembling the protoplasm of plants, whose energy in actively resisting the disintegrating inorganic forces of nature is so well known. Perhaps this type of force is an early-born of the primitive energy, one which has not descended so far in the scale as the chemism which holds so large a part of nature in the embrace of death.

Vibration is inseparable from our ideas of motion or energy, not excluding conscious energy. There are reasons for supposing that in the latter type of activity the vibrations are the most rapid of all those characteristic of the forces. A centre of such vibrations in generalized matter would radiate them in all directions. With radiant divergence the wave-lengths would become longer, and their rate of movement slower. In the differing rates of vibrations, we may trace not only the different forms of energy, but diverse results in material aggregations. Such may have been the origin of the specialization of energy and of matter which we behold in nature.

Such thoughts arise unbidden as a remote but still a legitimate induction from a study of the wonderful phenomenon of animal motion, — a phenomenon everywhere present, yet one which retreats, as we pursue it, into the dimness of the origin of things. And when we follow it to its fountain-head, we seem to have reached the origin of all energy, and it turns upon us, the king and master of the worlds.

MICROSCOPIC SCIENCE.[1]

PROF. T. G. WORMLEY delivered no formal address. He gave only a short discourse, in which he described the advantages and possibilities of two special applications of the microscope: first, to the detection of very minute quantities of certain poisons, notably arsenic, by the examination of the sublimate; second, to the examination of blood stains. He described the limits within which identification of different animals, and the recognition of human blood, is feasible; he denied that human blood can be absolutely identified; he also stated that the result of prolonged experiments indicated that pure water is the best reagent for restoring the blood-corpuscles in a stain to their natural condition.

MAN IN THE TERTIARIES.[2]

IN studying the questions of his own origin and antiquity, man has been hindered by many prejudices and by many barriers of his own erection, the first and most formidable of which was the theological barrier of the Mosaic cosmogony. In process of time this was partially removed; but other barriers to free investigation arose, founded on the evidence collected by the very men who had done most to destroy the earlier obstacles. Cuvier declared that man, being the last and highest of creation, could never have been contemporary with the extinct species of mammals found in the quaternary beds. For a time all evidence to the contrary was treated with contempt; but Cuvier's massive authority was finally overthrown by Perthes, Schmerling, and others.

No sooner had the Cuvierian barrier against quaternary man been demolished, than smaller barriers of precisely the same nature were erected against the tertiaries. Gaudry could not admit that the worked flints discovered by the Abbé Bourgeois in the miocene of Thenay were the remains of men; because he found it difficult to believe, that, while every other species of the miocene is now extinct, man alone should have remained unchanged. Professor Dawkins in a similar line of argument assumes that man cannot be looked for until the lower animals now in existence made their appearance. In the eocene age there were none of the present living genera of placental mammals, in the miocene none of the present living species; and it is most unlikely that man should appear at such a time. At this period the apes (Simiadae) haunting the forests of Europe were the most highly organized types. Moreover, if man were upon the earth in the miocene age, it is incredible that he should not have become something else during those long ages in the course of which all the miocene land mammalia have either assumed new forms or been exterminated. And for similar reasons Professor Dawkins says he cannot expect to find traces of man in the pliocene. But such assumptions are obstructive: they not only put a check upon research, but they prevent the unbiased consideration of fresh evidence.

These theories have been greatly strengthened by the idea that man has been evolved from the higher apes, and that his nearest relations among these creatures are those which are supposed to have appeared last in the sequence. Nevertheless, we find the evidences of man associated with extinct apes, and the gap between them is by no means closed in these earlier horizons. In the earliest remains of man thus far recognized, we do not have the most pronounced ape-like features, as we should have a right to expect if both have sprung from the same stem, and if man is limited to the quaternaries. All these forms are still man, with a fair brain-case; though the slight modifications toward an ape-like structure have the deepest significance in clearly indicating the direction from which he sprang.

If paleontologists are right, the first anthropoid apes have been found in the middle eocene, and later still a more generalized form called Oreopithicus; and side by side with these are found chipped flints if we are to accept the authority of their discoverer Bourgeois and the opinion of Mortillet and others. If man existed then, — and on theoretical grounds there is no reason to believe that he did not exist, — we must look much farther back for the approach of these two groups.

The earliest evidences of man must be sought in his remains, and not in his works: but the very conditions of life which characterized early man and his associates render the preservation of their remains a matter of extreme improbability. The herbivora in herds, seeking the shelter of watery places, would in dying become mired, and thus preserved in a matrix for the future explorer. Aquatic forms are infinitely more abundant as fossils than land or aërial forms, — water-birds than land-birds. The arboreal ancestors of man, and the probable habits of man himself, would leave their bones to bleach in the field or forest, to decompose and disappear long before [illegible] entombment was possible. It was only when man acquired the art of sepulture, or sought refuge [illegible] caves, that the preservation of his remains became assured. Surface changes, however, have been [illegible] wide-spread and profound as to nearly obliterate [illegible] trace of these places, and when preserved the harvest from them has been of the most meagre description. Of nearly fifty caves examined by Schmerling in Belgium, only two or three contained human remains. Lund, who examined eight hundred caves in Brazil, found only six containing human remains. The grain of the Swiss lake-dwellers, and even the bread they made, have been preserved; but human bones are of scanty occurrence. The Danish peat-beds have as yet yielded none, though stone implements and other objects are found there in abundance.

Chief among the agencies in destroying the evi

[1] Abstract of an address before the section of histology and microscopy of the American association for the advancement of science, at Philadelphia, Sept. 4, by Prof. T. G. WORMLEY of the University of Pennsylvania, vice-president of the section.

[2] Abstract of an address to the section of anthropology of the American association for the advancement of science, at Philadelphia, Sept. 4, by Dr. EDWARD S. MORSE, of the Peabody academy of science, Salem, Mass., vice-president of the section.

dences of man have been the glacial floods; and these, if the glacialists are right, have occurred, one during the earlier pliocene and the other at the beginning of the quaternary. In the gradual recedence of the glaciers, no less destructive agencies were at work in scooping out valleys, inundating immense areas, and covering broad tracts of land by their detritus.

It would seem from many facts, that early man lived in the vicinity of water, either on the banks of rivers or along the coast-line; and it is just these regions which have been most profoundly modified since glacial days, and, indeed, in all times.

Saporta suggested the idea that man, originating in the north, had been pushed southward by successive waves of people till the primitive wave was forced into the extremities of the southern continents, and that the remnants of this ancient wave are seen in the Tasmanians, Bushmen, and Fuegians. If so, the remains of primitive man are buried under paleochrystic ice. Far more probable would it be to assume an antarctic continent under genial conditions in which these primitive races lived, and whence successive waves emanated, becoming modified by their new surroundings as they receded from their point of origin. We should then assume the submergence of this region; leaving remnants of these low types in the Patagonians, Tasmanians, Bushmen, and others, and precisely where we might expect to find them. If either supposition is true, the earlier traces of these people are buried beyond recovery. The prejudices of man himself have also caused the loss of much precious material, or of opportunities which can never be regained, — ancient skeletons exhumed only to be promptly buried again; others encountered in excavation, and left undisturbed through superstitious fear. Even at the present time, while the collection and study of the remains of other fossil mammals go on unchallenged, the archeologist is beset by a class who repudiate his facts, look upon his evidences as deceptive or fraudulent, and misunderstand his aims.

From what has been said, it is evident that the discovery of the remains of primitive man is highly improbable. Until this good fortune comes to us, as come it may, we must be content to reason from the known to the unknown. In regard to the physical characteristics of man, there is a manifest disproportion between the changes he may have undergone, and the known change of other mammals since miocene days. For, while slight changes in man's osteological structure have undoubtedly taken place, many mammals of huge form and great variety have become extinct, and others have been profoundly modified. On the other hand, it seems reasonable to believe, that, the moment the ancestors of man possessed the power of banding together in communities, and of using weapons, they became capable of rendering inoperative the very influences which were so active in modifying or exterminating their mammalian associates. How far these conditions were settled in the quaternary, may be seen from the fact, that while man could endure an arctic climate, and survived the glacial period, his anthropoid and more distant pithicoid relations disappeared from Europe forever on its approach.

The fact that man, and his near associates, have been regarded as structurally the highest forms of mammals, has led to the natural belief that they must have been last evolved. That man is pre-eminently the highest form intellectually, goes without the saying; but in regard to his physical characteristics it seems that sufficient importance has never been given to the generalizations of Cope, who shows that "the mammals of the lower eocene exhibit a greater percentage of types that walk on the soles of their feet, while the successive periods exhibit an increasing number of those that walk on the toes, while the hoofed animals and carnivora of recent times nearly all have the heel high in the air. . . . Thus, in all generalized points, the limbs of man are those of a primitive type so common in the eocene. His structural superiority consists solely in the complexity and size of the brain. A very important lesson is derived from these and kindred facts. The monkeys were anticipated in the greater fields of the world's activity by more powerful rivals. The ancestors of the ungulates held the fields and the swamps, and the carnivora driven by hunger learned the arts and cruelties of the chase. The weaker ancestors of the quadrumana possessed neither speed, nor weapons of offence or defence; and nothing but an arboreal life was left them when they developed the prehensile powers of the feet. Their digestive system unspecialized, their food various, their life the price of ceaseless vigilance, no wonder that their inquisitiveness and wakefulness were stimulated and developed, which is the condition of progressive intelligence." This explains on rational grounds why man has continued to persist for so long a time with physical characteristics so slightly modified, while other forms were changing or becoming extinct.

It has been shown that structurally he is related not only to the higher apes, but with numerous lower forms, and even with the lemuroids, remains of which have been found in the lower eocene of both continents. If these structural affinities are valid, then we must look far beyond and below the present higher apes for the diverging branches of man's ancestry.

Another evidence of his antiquity is the early establishment of well-marked types, which must have required an enormous lapse of time to have become established. The various types of skulls are met with among the earliest traces of man. In the lake dwellings of Switzerland, Dr. His has discovered four different types of skulls.

Professor Kollman, who has made an extensive study of the crania of both hemispheres, concludes that the sub-species of man became fixed in the pre-glacial period. Furthermore, the evidences go to show that early man had become sufficiently differentiated to acclimate himself to widely different regions of the earth's surface, while the apes are still confined to the torrid zone. The remains of his feasts show that he had early become omnivorous. The most powerful argument in favor of tertiary man lies in the fact that his earliest remains are not confined to

any one region of the earth. The river-drift men are found impartially scattered from tropical India through Europe to North America. If their distribution was by the northern approaches of the continent, it must have been in pre-glacial times, because, as Dawkins shows, an ice-barrier must have spanned the great oceans in northern latitudes.

It seems an almost fruitless speculation, to inquire into the manner of their dispersion, yet one is tempted to surmise that if they originated in the tropics, then submerged continents must again be restored to offer the necessary means for such a dispersal. If, on the other hand, their home was in the north or south temperate zone, and the distribution circumpolar (and this seems more probable), then we have another evidence of the wide separation which the race had acquired, at that early day, from its tropical relatives the apes. Whatever the facts may ultimately show, this unparalleled distribution of a people in the lowest stages of savagery proves beyond question that man must have pre-existed for an immense period of time; for, with the known fixity of low savage tribes, the time required to disperse this people over the whole earth can only be measured by geological centuries.

The farther we penetrate into the past, and ascertain some definite horizon of man's occurrence, other observers in widely different regions of the earth bring to light traces of man's existence in equally low horizons. The evidence of the remoteness of man's existence in time and space is so vast, that, to borrow an astronomical term, no parallax has thus far been established by which we can even faintly approximate the distance of the horizon in which he first appeared. From this fact we are justified in the assumption that the progenitors of quaternary man, under different genera possibly, must be sought for in the tertiaries.

Science will not gain by the erection of any theoretical barriers against tertiary man, until such definite forms are met with that shall reasonably settle the beds in which he first occurred. We know in what rocks it would be obviously absurd to look for his remains or the remains of any mammal. So long, however, as forms are found in the lowest beds of the tertiaries, having the remotest affinity to his order, we must not cease our scrutiny in scanning unbiased even the rocks of this horizon, for traces of that creature who, until within a few short years, was regarded as some six thousand years old, and who, in despite of protest and prejudice, has asserted his claim to an antiquity so great, and a dispersion so profound, that thus far no tendency to a convergence of his earliest traces has been demonstrated.

SCIENTIFIC METHODS AND SCIENTIFIC KNOWLEDGE IN COMMON AFFAIRS.[1]

Economic science and statistics can hardly do less than to promote the use of scientific methods, and disseminate scientific knowledge in common life. Science has had a hard struggle with ignorance. A host neither small nor amiable has been arrayed against it. What wonder, then, that it has first intrenched itself where the use of instruments of precision and the demonstrations of mathematics separated it from the critical issues of man's every-day conduct? Nevertheless, history may in the remote future express surprise that in America, where the power and conduct of man are so important, science has so long neglected the rugged issues assigned to this section.

There is now no good reason why scientific men should neglect to apply scientific methods to the economy and statistics of every-day life. If mathematical principles and processes are applicable to the statics and dynamics of physics, why not also to the statics and dynamics of society? If useful in economics, why not in personal and domestic life? True, in all questions of conduct, we must include man's free action of will, and leave room for doubt or for alternatives or for contrary choice; yet how many questions of daily life are left to the merest conjecture, to superstition, or to the wild estimaginings, and how large a percentage of blunders might be avoided! We smile that a pagan commander moved his army by the flight of a crow or by the aspect of an animal's entrails; but how many merchants sail their ships, and agriculturists plant or harvest, by the guesses of charlatan weather-prophets, or how many actions are determined by seeing the moon over the right shoulder, or by confidence in a horseshoe! Myriads of groundless notions to-day affect the conduct of personal and public affairs. It is time for science to enter. Many a juggler would then lose his business, many a prejudice have to be given up. Pockets, policies, and politics are involved in the issue. The disposition to revel in the marvellous, to dally with uncertainties, and to treat all mystery as concealing the superhuman, would be disturbed. The phrases 'we guess,' 'we reckon,' are giving way to the phrases 'we will inquire,' 'we will try to know.'

Sir William Thompson has said, "Accurate and minute measurement seems to the non-scientific imagination as a less lofty and dignified work than looking for something new;" but he adds, "Nearly all the grandest discoveries of science have been but the rewards of measurement and patient, long-continued labor in the minute shifting of numerical results." Thus the methods of economic science are the same as those of other branches of science, while the latter also yield statistical results.

It is unfortunate that scientific men aspire so exclusively to original research. We need men to couple love of science with love of mankind. Livingstone desired to explore Africa for science, but as much so for the civilization of benighted Africans. Is science for man, or man for science? Is not benefit to mankind the real measure of the good that is in science?

Doubtless Stephenson was more perplexed with the mood of the parliamentary committee than with the questions of improving his steam-engine. From a

[1] Abstract of an address before the section of economic science and statistics of the American association for the advancement of science, at Philadelphia, Sept. 4, by Gen. John Eaton, U. S. commissioner of education, Washington, vice-president of the section.

member of that committee came the absurd question, 'Would it not be a bad fix if the engine should meet a cow on the track?' 'Yes,' said Stephenson, 'it might be bad for the coo.' The dissemination of truth is as scientific as its discovery. Sometimes scientific men act as if truth could not be expressed in the vernacular, — indeed, as if it cannot be truth unless dressed in their terminology. College men used to feel that their triennial would lose character if deprived of the dignity of Latin — though it was often bad Latin. All this foolishness is fast passing away. Already it is an honor to scientifically *teach* science, as well as to advance its domain. Still it is rarely met with, and far less understood than scientific research. Here is a great field for immediate occupancy.

The scientific method of communicating truth recognizes the fact, that in early life man's powers are shaped, and too often the bulk of his knowledge acquired. Hence its fundamental rule must be simplicity in the use of language, and in the presentation of each truth in the concrete. This scientific method is needed even to preserve classic learning from disgrace and disuse. Adopted in the whole domain of scholastic instruction, it would bring new votaries to science, and new benefactors even to the support of pure science. A better taste for all kinds of literature would result. Low writing would be at a discount. We should thus cheapen scientific literature, and increase museums for object-teaching. We may never destroy the taste for low and degrading prints by inveighing against them and thus advertising them, but we may create a taste for valuable reading which will not be satisfied by the vile. This literature cannot be the same for all persons, but the scientific method should pervade it all. Morals would not be excluded, but enforced; the imagination not neglected, but purified and elevated. The body of information could not exclude any truth of service to mankind. Every great subject would bring its contribution shaped to scientific methods and adapted to all minds, — the earth as influenced by the sun and the starry world, its surface of land and water, of mountains and streams and valleys, of barren and productive soil, the plant life that dwells upon it, the animal life it supports, the circumambient atmosphere and its phenomena; and man, the scientific animal who makes all this ado, and for whom it is made, and to whom it is given to possess. The Adam of this period of scientific thought might call up his several sciences, and direct each to yield what it possesses for this correlation of economic thought, for human instruction, guidance, enjoyment, and betterment, for this evolution of science, for the greatest good of man by doing its utmost for the common things of daily life. Gravitation weighs alike the most volatile particle and the vastest of far-off stars. The laws of economic science are the same to the lowly as to the great man: by them he measures the price of his salt, and the safeguards of his liberty.

Towards this gathering-up, for man's daily use, of all the lessons of nature, the progress of the race is tending. Steam, the telegraph, and the telephone focus all thought and action. We shall yet demand of every department of knowledge, 'What good for man?' Each science will have its body by itself, and yet fill numerous relations to every art, and yield its practical lessons to every man according to his understanding and preparation. Data thus correlated will meet the child, — nay, will guide the paternal influence and action in its behalf. But now the child, in its greatest dependency, is met with the destructive follies of ignorance. Neglect, mistakes, or downright violations of nature's laws, often consign him to the grave, or plant in him the seeds of permanent disorder. Physicians may relieve his colic, or cure his disease; but how rarely can they so direct the nursing and training as to assure health! If the impairment is mental, and we go to insane-asylums for advice, we learn what per cent of the cases under treatment could have been prevented, and efforts will be made to cure. But we want prevention, not cure. We want information upon questions of food, of raiment, of shelter, of air, of vocation, of occupation; not for one man, or one class of men, but for all men in all conditions.

The era of this diffusion of knowledge has already actually commenced. Men not engaged in scientific pursuits are gradually coming to feel the necessity of gathering, grouping, and generalizing the data which give them a clearer measure of health, comfort, pleasure, as well as the profit and loss involved. As balance-sheets are studied in business, so are questions of finance, of taxation and public expenditure. Great operations, like those in corn, in coal, in cotton, in wool or silk, leather or lumber, in iron or gold or silver, and of all the great industries, — agricultural, mechanical, commercial, professional, — demand and have their collections of statistics, and their vast accumulations ready as contributions to economic science. But the correlation of all these and their actual results have not yet been reached. Nevertheless, money sees the profits of this wisdom, and is more willing to pay for it. Expert investigators are in demand. Public action requires it. The idea of a republic in which all its citizens shall act patriotically and virtuously, from free choice of the right course and on their own knowledge, demands it. Napoleon I. said, 'Statistics mean the keeping of an exact account of a nation's affairs, and without such an account there is no safety;' while Goethe declared, 'I do not know whether figures govern the world, but this I do know: they show *how* it is governed.' America has accepted the responsibility of reporting its operations, and of disseminating information for the benefit of all the people. Boards of health, of charity, of education, and bureaus of statistics and labor, are demanded by state and nation. They are becoming potent in reducing to order the chaos of data so long without form and void.

The character of the information demanded marks the progress of the age. During how many ages was the counting of men and the measure of their condition undertaken solely to prepare for war! Even our own colonial census was taken for this purpose.

The constitution of our fathers provided for representation in congress and in the electoral college according to population. This has led to vast results. A magnificent world of data is now spread before us by the census. Every man, woman, and child, and their interests, enter into it, and it has its lesson for each in all their various capacities and relations; but not more than a hundred thousand can possess it, and few can master the whole of it. It would be too much to come annually, and therefore cannot be frequent enough to meet every condition. Many statements should be annual. Our system of government affords an excellent opportunity to perfect a system of statistics parallel to the decennial census, and fitted to meet all demands.

Publicists have said much of the importance of the town-meeting as found in New England. An important characteristic of it is the bringing of all questions of public taxation and expenditure and policy to the consideration of all the citizens. This attention of all the citizens to the details of municipal action in large cities is impossible: therefore there are public reports and manifold statements. But should the town system of reports be everywhere adopted, and these be followed by county and state summaries, the nation could group these so as to give a variety of form and result sufficient for each according to his interest. The student and statesman would find them falling into appropriate classes, of sufficient frequency, and in connection with our decennial census of the nation would discover us in the very front rank with respect to knowledge of ourselves as a people. This is now done measurably for the subject of education. Each institution publishes its report or catalogue, most towns and cities their reports; many states gather up the data; and the national bureau, carefully avoiding improper complications, and solely for the purposes of information, issues an annual volume. The result is unique in the history of voluntary statistics. Were this system carried into every other great field, and the whole distilled into a single volume, and should each nation do the same, we should see the beginning of a solid foundation for internationalism, and the scientific method at last pervading the world of thought. It would determine the most far-reaching generalizations, and have an effect upon common life not now possible. Childhood would be ushered into new conditions, and alike the humblest and the highest would more easily find the truth.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE MATHEMATICAL AND PHYSICAL SCIENCE SECTION.

THE session of the British association in Montreal might be fairly designated as a 'section A' meeting, in view of the leading position in British science occupied by the representatives of that section, and the prominence which was accorded them and their section in the general meetings of the association. The retiring president of the association, who was to have been present, but was not, was a distinguished member of the section. His few duties were gracefully performed by another distinguished member of the section, Sir William Thomson, who also presided over the sittings of the section during the meeting. As representing the retiring president he introduced his successor, the president for 1884, in the person of Lord Rayleigh, another of the 'strong' men of section A. Two of the three evening lectures were given by members of the section, on subjects connected with physics and astronomy.

When it is remarked that the place of meeting offers no especial attractions to students of mathematical and physical science, it will be admitted that the roll of the section presented an unusual array of great names, including as it did such as Sir William Thomson, Lord Rayleigh, J. C. Adams, J. W. L. Glaisher, Henrici, Dewar, Preece, James Glaisher, Lodge, Rev. S. J. Perry, Osborne Reynolds, and many others.

As might be easily inferred from a glance at the above list, a large majority of the papers presented had to do with physics rather than with astronomy or pure mathematics. By a judicious action of the sectional committee, and one worthy of imitation, the papers were very fairly 'bunched' by subjects so that one was not required to remain during the entire week in order to listen to the treatment of a particular topic.

The first notable physical paper to be presented was, of course, the address of Lord Rayleigh as president of the association.

This address has already been placed before the readers of this journal, and no extended reference to it will be necessary. Although historical in the main, it was rich in valuable and timely suggestions such as could come only from one as thoroughly familiar with the topics referred to as its author. As a sample of these, may be quoted the remarks concerning the theory of the action of the telephone, which was declared to be "still in some respects obscure, as is shown by the comparative failure of the many attempts to improve it;" and in considering some of the explanations that have been offered, Lord Rayleigh said, "We do well to remember that molecular changes in solid masses are inaudible in themselves, and can only be manifested to our ears by the generation of a to-and-fro motion of the external surface extending over a considerable area. If the surface of a solid remains undisturbed, our ears can tell us nothing of what goes on in the interior."

The address of Sir William Thomson as presiding officer of section A must be carefully read and studied to be appreciated. One or two of the 'steps towards a kinetic theory of matter' may be usefully referred to. The as yet unsurmounted difficulty in the kinetic theory of gases is the explanation of what actually takes place during a molecular collision. It need hardly be said that physicists will not be satisfied until more or less of the obscurity surrounding this subject is dissipated. The mutual action at the moment of collision has been generally assumed to be repulsive by all who have written of or contributed to the kinetic theory. Sir William Thomson asks, May it not, after all, be attractive? Under certain conditions it seems that the appearance of repulsion may be the result of attraction. In general, two molecules approaching each other with a high velocity, assumed to be due to their attraction for each other, will approach obliquely, as the chances of a square 'hit' will be exceedingly small; they will then dash past each other in sharply concave curves around their centre of gravity, and fly asunder again, something, indeed, after the fashion of a comet passing around the sun. "A careless onlooker," says Sir William Thomson, "might imagine they had repelled one another." The idea that this mutual action might be attractive rather than repulsive had been in his mind for thirty-five years, but up to the preparation of this address he had never made any thing of it.

But, after all, the molecules must be infinitely small in order that they may *never* come in actual contact, so that we cannot evade the consideration of the effects of these real impacts when they do occur. Concerning these impacts, but two views seem to be open to us: the one is to imagine the molecule to be a little elastic solid; the other, to conceive it to be a 'configuration of motion in a continuous all-pervading liquid.' It is hardly necessary to say, that, in the opinion of Sir William Thomson, the latter must be the final hypothesis upon which we may rest.

But as a convenient intermediate station he suggested the conception of an elastic molecule, out of which we might not only construct a model of a gas, but, with some satisfaction, by linking these molecules together we might explain the elasticity of a solid. In a paper presented to the Royal Society of Edinburgh in March, 1883, of which the title only had been published, he had shown how an elastic system may be constructed, composed entirely of suitably disposed masses in motion. A system of four gyrostatic masses connected together by links was shown to possess all of the properties of an ordinary elastic spring, although composed of matter in itself entirely devoid of elasticity. By properly linking great numbers of such gyrostatic systems together, a model of an elastic solid results. Such a hypothetical solid lends itself easily to the explanation of such effects as the rotation of the plane of vibration of a wave transmitted through it, as in Faraday's celebrated experiment of the rotation of the plane of polarization of a ray of light in a magnetic field.

Sir William Thomson considered further the possibility of discarding entirely the postulate of rigidity in the materials under consideration, and showed how a hydrokinetic model of matter might be constructed in which all the effects of 'action at a distance' might take place. By means of this the model of a perfect gas might be produced, in which, however, there still exists the difficulty of explaining the case of actual impact of the particles. Some ingenious suggestions were made in the way of surmounting this difficulty; and the whole address was enriched by the most delightful digressions on the part of the author, during which the manuscript was neglected, and the section was afforded the pleasure of following, as best it could, the great physicist in his involuntary excursions into this most interesting but little-explored domain of physical science.

Lord Rayleigh, in his presidential address, had referred at some length to recent investigations concerning the theory of lubricants; and the section was therefore in a favorable mood to listen to the first regular paper on the programme, which was a theoretical consideration of that subject by Professor Osborne Reynolds.

The hitherto unrecognized results obtained by Mr. Tower in his experiments were referred to, Mr. Reynolds undertaking to show that they were in strict accordance with our knowledge of the laws of motion of viscous fluids. Mr. Tower had found, that when the rotating journal with its box was immersed in a bath of the lubricant, the resistance was not more than one-tenth of its value in ordinary oiling, and that the journal was less likely to heat at higher than at lower speeds. By boring a hole through the top of the box, it was found that the oil was forced through with considerable velocity; and on attaching a pressure gauge, as high as two hundred pounds per square inch was indicated. The oil appeared to be carried up by the motion of the journal, and to form a film upon which the box rested. Mr. Reynolds showed that there would necessarily result a difference of pressure on the two sides of the vertical line through the centre of gravity in the thin space between the box and journal; the maximum being on one side or the other, according as the rotation is one way or the other. Mr. Tower had found, that if, after running the journal for some time in one direction, a reversal were made, great heating would result. Owing to the difference of pressure above referred to, it was to be expected that this would occur; as, undoubtedly, the box and journal became adapted to each other for a certain direction of running, and when a reversal was made some time would elapse before a re-adaptation would be completed. This would explain why a new journal and box would *always* heat on first being run, however perfect they may be. Mr. Tower had likened the operation to a stroking of the fibres of the metal in one way by one direction of revolution, and the reverse stroking at the early part of a reversed motion; but this was not the true explanation, as the resistance was evidently a shearing resistance, the sliding of one layer of oil over the other. Sir William Thomson, in commenting upon the paper,

called attention to the fact that one solid cannot slide over another without *tearing*.

Professor Reynolds also presented an interesting paper on a method of illustrating the second law of thermo-dynamics by means of kinetic elasticity. If a long flexible cord or chain be suspended with a weight at the lower end, the weight may be lifted a considerable distance by communicating a vibratory motion in a horizontal plane to the upper end of the chain. It then represents an absolutely reversible engine. If the weight, when at an elevated point, be removed from the chain, to straighten the chain out will require as great an expenditure of energy, not counting dissipation through friction, etc., as was consumed in raising the weight. It was shown that in this model the mean square of the velocity of the chain, multiplied by the weight per unit of length, corresponds to the heat in Carnot's engine. Another form of the device consisted of two vertical cords to which a number of horizontal bars of wood were attached at equal distances. In discussing the paper, Professor Fitzgerald described a very pretty illustration of the same principle by means of a 'balanced governor,' with a chain and weight attached in such a way as to be in equilibrium in all positions, the details of which are difficult to describe without the aid of a diagram.

The subject of the relative vapor tensions of a body in the liquid and solid state at the same temperature was discussed in a paper by Professor Ramsay and Mr. Sydney Young.

Professor James Thomson long ago pointed out that there must be a sudden change in the curve of vapor density of water at the point of solidification; and showed that this change was really to be detected in Regnault's results, but that Regnault himself had not thought such a break to occur, and had 'smoothed' his curve at this point; believing errors of observation to be sufficient to cover the discrepancies.

Messrs. Ramsay and Young, by means of ingenious devices, had overcome some of the difficulties of the experimental investigation, and had experimented upon camphor, benzine, water, and several other substances. The results were in accordance with the previously accepted views, and in the case of water were found to agree with those based upon Professor James Thomson's formula.

Radiation was the subject of two or three papers. Professor Dewar offered the methods and results of an investigation of the law of total radiation at high temperatures. The plan and arrangement of the apparatus for the research were ingenious and effective; and Professor Dewar stated that he had just learned from Professor Newcomb, that he had some time before devised and described an arrangement for the same purpose, identical in principle with that made use of in his own work.

For relatively low temperatures, Professor Dewar made use of an iron vessel containing mercury, into which a thermometer-bulb was pushed. The radiation measured was that from one side of the vessel, which was made of exceedingly thin iron; and the heat was received upon the face of a thermopile enclosed in a case properly screened, and arranged so that a steady current of water would be used to maintain constancy of temperature at one face. For these lower temperatures, the equation expressing the amount of radiation was of the ordinary parabolic form, the radiation being nearly proportional to the square of the temperature. The difficulty in dealing with high temperature is, that most substances undergo an alteration in the character of the surface when the temperature is very much raised. The arrangement finally adopted consisted essentially of a platinum air thermometer, the bulb of which was enclosed in a small furnace with a small opening through which the radiation took place. The walls of the platinum bulb were very thick, nearly a quarter of an inch in the actual experiment, and the bulb was connected with a mercury manometer for determining the pressure. Experiments were also made to determine the radiation when the thermopile was protected by an iodine screen. The results were as follows, the numbers being in arbitrary units: —

Radiation at 600°	. 15.5,	screen used,	8.
" " 700°	. 19.5,	" "	12.2
" " 800°	. 20.0,	" "	19.5
" " 900°	. 42.5,	" "	29.9
" " 1000°	. 60.5,	" "	44.0
" " 1100°	. 84.5,	" "	66.0

The assumption was made, that the radiation was represented by some power of the temperature; and this power was found in the first case to be 3.4, and in the second 3.3, thus showing a tendency to approach the fourth power; and attention was called to the fact that many of the results of Dulong and Petit were well represented by the equation $R = at^4$.

Mr. J. T. Bottomly offered a paper on the loss of heat by radiation and convection as affected by the dimensions of the cooling body, and on cooling in a vacuum; which, on account of the absence of the author, was read by Sir William Thomson. The paper was based on an extensive series of resistance measurements of copper wires under various conditions, accepting the well-known coefficient of increase of resistance of copper for increase of temperature. The conclusion was reached, that the emission power was greater for small wires than for large ones, and that it diminished with the pressure.

It would be almost impossible to give a perfectly clear idea of Sir William Thomson's paper on a gyrostatic working-model of the magnetic compass, without quoting the paper entire. What he proposes to accomplish may, however, be readily understood. At the last meeting of the association, at Southport, he had explained several methods for overcoming the difficulties which seemed to have defeated all previous attempts to realize Foucault's "beautiful idea of discovering with perfect definiteness the earth's rotational motion by means of the gyroscope." He had there shown that a gyrostat supported, without friction, on a fixed vertical axis, with the axis of the fly-wheel approximately horizontal, will behave exactly as does a 'magnetic compass,' only with ref-

erence to the true or rotational north rather than the magnetic north. A method was there presented for so mounting a gyrostat about such vertical axis as to reduce the friction to a minimum. The present paper was concerned principally in the presentation and discussion of another and simpler plan for realizing the same idea. The plan consisted essentially in suspending a gyrostat, properly constructed, by means of a very long and very fine steel wire attached to a torsion-head, capable of being turned about a vertical axis, at the top. The gyrostat being suspended, by successive adjustments of the position of the torsion-head, a position is found in which the position of the gyrostat, in relation to the torsion-head, shows that the wire is free from torsion. In this position the axis of the gyrostat will be in the true north-and-south line; and, if disturbed from this position, it will vibrate about it precisely as does an ordinary magnetic needle about the magnetic meridian.

The author pointed out several difficulties in the way of the complete realization of the idea, and closed by suggesting some possible methods of mounting, in a simple way, a gyrostat free to move about an axis rigorously or very approximately vertical. Regardless of any practical results which may come from it, the suggestion of a gyrostatic compass is singularly interesting as an example of how *motion* may effectively take the place of a directing *force*, although only one of the many which Sir William Thomson has furnished.

As was naturally to be expected, topics bearing upon the subject of electricity occupied a good share of the time of the section. Unfortunately one or two papers bearing upon this subject had been assigned to the chemical section, and were presented contemporaneously with the electrical discussion in section A. The paper by Professor Frankland, on the chemical aspects of the storage of power, was one which many members of section A would have been delighted to hear. While it was being read, however, section A was engaged in an extremely interesting discussion of the question of the seat of the electromotive forces in the voltaic cell, which was opened by Professor Lodge. For the first time in the history of the association, the experiment was attempted, of assigning a definite topic for general discussion; and the success was such as doubtless to lead to a permanent establishment of the custom. The selection of Professor Lodge to open the discussion was extremely fortunate. He is not only a ready and clear expounder of his own views, but he was fortunate, as a leader in the discussion, in that those views were not those which are generally accepted as being orthodox. His opening paper was largely historical; in fact, too largely so in the opinion of many of his hearers. He traced the history of the discussion from the time of Volta, declaring that the only really great contributions to our knowledge of the subject were those of Volta in 1801 and of Sir William Thomson in 1851. Of late years the so-called contact theory had been generally accepted. This theory, as generally understood, Professor Lodge could no longer accept. He did not believe that two metals in air or water or dilute acid, but not in contact, are practically at the same potential; or that two metals in contact are at seriously different potentials, or that the contact force between a metal and a dialectric, or between a metal and an electrolyte, is small. He did believe that by far the greatest part of the electromotive force of a voltaic cell exists at the zinc and liquid contact rather than at the zinc and copper contact, as generally supposed, although he believed that there was an electromotive force at the junction of every two substances. A summary of the argument may be briefly given as follows, which, as far as it goes, is in Professor Lodge's own words:—

Wherever a current gains or loses energy, *there* must be a seat of electromotive force; and conversely, wherever there is a seat of electromotive force, a current must lose or gain energy in passing it.

A current gains no energy in crossing from copper to zinc, hence there is no appreciable electromotive force there.

When a current blows from zinc to acid, the energy of the combination which occurs is by no means accounted for by the heat there generated, and the balance is gained by the current; hence at a zinc acid junction there must be a considerable electromotive force (say, at a maximum, 2.3 volts).

A piece of zinc immersed in acid is therefore at a lower potential than the acid; though how much lower it is impossible to say, because no actual chemical action occurs.

It was not to be expected that this statement of views, differing so greatly from those usually held, would be received without some protest, and particularly from Sir William Thomson, who has been regarded as the chief exponent and expounder of the metallic-contact theory. Professor Lodge was perfectly successful in inaugurating a discussion which was full of interest; although it can hardly be said to have contributed much to the discovery of a substantial basis of agreement, as he had evidently hoped. Sir William Thomson presented his own views at some length. The subject was one surrounded by great difficulties. He thought there could be no doubt as to a difference of potential at the zinc-copper junction, but the question of the electro-motive force of a voltaic cell might be separated from that of difference of potential at the junctions. He fully agreed with Professor Lodge in his view of the seat of the 'working-force' in the cell. The 'working-force' was essentially chemical force. Undoubtedly, in a certain sense, both the chemical and voltaic or contact views of the question were correct.

Professor Rowland, on being called upon to express his opinion, with characteristic frankness declared that he knew nothing about it. Professor Willard Gibbs called attention to the fact that this was a case similar to several other well-known physical problems, in which an attempt to determine the exact point or place at which a force resides had not been rewarded with success. In such cases much depends upon the standpoint from which the subject is viewed, and it

sometimes happened that each of several quite different explanations of a phenomenon might be perfectly correct. This proposition came nearer affording a 'substantial basis of agreement' than any thing else; but it cannot be denied that the impression remained on the minds of many in the section, that the extreme views were nearly, if not quite, irreconcilable with each other. Among the interesting results of the discussion was the somewhat unexpected limitation put upon the generally accepted idea of the 'potential of a body,' by Sir William Thomson. This he defined to be the energy expended in bringing unit electricity from an infinite distance to a point in air extremely near the surface of the body.

Lord Rayleigh described a galvanometer of twenty wires which he had constructed, by joining the wires in multiple arc and also in series, so that the constant of one circuit was exactly ten times that of the other. The instrument was useful for the accurate standardizing of ammeters for measuring currents of from ten to fifty amperes. Professor Shuster discussed the influence of magnetism on the discharge of electricity through gases. He had found that this influence was very different upon the discharge from large electrodes from those usually observed when small electrodes are used. The construction of an apparatus of peculiar form, with large electrodes, had enabled him to obtain many curious effects by the introduction, between the electrodes, of electro-magnets of various forms. He had also found that none of the usual Crooke's effects are produced in mercury-vapor tubes, and this was connected in the theory of the operation with the fact that mercury was a monatomic substance.

In the discussion of a paper by Lord Rayleigh on telephoning through a cable, Mr. W. H. Preece related his experiences in telephoning the Dublin and Holyhead cable, a distance of sixty miles, which had been fairly successful; accurately heard conversation, however, could not be carried on beyond a distance of twenty-five miles. Other experiments had proved that it was at present impracticable to use underground wires in cities for distances of more than twelve miles. In every experiment telephonic circuits were made metallic. With an arrangement of double lines he said he had no difficulty in speaking through two hundred and forty miles on overground wires.

The much-talked-of, and one might justly say the much-abused subject, of the connection of sun-spots with terrestrial phenomena, received considerable attention in a discussion which was opened by Prof. A. Schuster. It is generally agreed that sun-spots have a periodicity; the length of their period being somewhat irregular, varying, indeed, from about eight years to fifteen or sixteen years, but the mean from maximum to maximum being about eleven years. This period might be the resultant of several periods superposed; and Professor Balfour Stewart had pointed out the fact that the irregularity observed could be fairly well accounted for by supposing the superposition of two periods of about ten and a half and twelve years respectively.

The first noticeable effect of this sun-spot cycle was the corresponding cycle in the daily variation of the magnetic needle, — a relation which was also generally admitted. From maximum sun-spot area to minimum sun-spot area, the daily variation of the needle changes in the ratio of about three to two; and in at least two instances brief but violent disturbances in the sun had been known to be accompanied, or at least followed closely, by similarly brief but marked disturbances of the magnetic needle. Such was undoubtedly the case in 1859, as observed by Carrington; and again in 1872, as observed by Professor Young. Professor Loomis has shown that there is an intimate relation between the sun-spot cycle and that of the aurora borealis; and, in fact, the practical agreement of those three cycles — the sun-spot, the magnetic, and that of the aurora — may now be considered as universally admitted. But although much time and great labor have been expended in this direction, it must be admitted that no other connection of solar disturbance as shown in sun-spots, with terrestrial phenomena, has been so completely proved as to command general confidence.

The question of accounting for the magnetic influence had been considered. Were the sun made of solid steel, and magnetized to saturation, it could not produce the effects upon the magnetic condition of the earth which are now justly attributed to it. Whether electricity is conducted in some way or other from the sun to the earth, is a question which cannot at present be answered, although it would be rash to affirm that the space between the sun and the earth does not contain enough matter to conduct electricity. It has been suggested, that variations in the amount of heat radiated from the sun might be shown to be an important factor; and some determinations of the total solar radiation have seemed to indicate that the total amount varied from time to time by as much as eight per cent. But the measurement of the sun's radiation is surrounded by the greatest difficulties, on account of the unknown and possibly varying absorption of the earth's atmosphere. Professor Schuster was convinced that the only mode of attempting the solution of the problem lay in the direction of evading this disturbance by establishing observing stations on the highest accessible points; and he suggested the Himalaya Mountains as offering, on many accounts, the most suitable locality. As the question now stood, he believed he was correct in saying that we know nothing of the variation of the sun's radiation.

The question as to the possibility of investigating the problem, through observed temperature effects upon the surface of the earth, had naturally been considered. In spite of the difficulties surrounding the subject, there could be no doubt that several different observers had proved that a connection existed between the sun-spot period and certain temperature effects upon the earth. Among these effects may be mentioned the agreement between this period and the best wine years on the Rhine; and also with the period of the increasing and decreasing number of cyclones upon the Indian Ocean.

As to a similar period in mean atmospheric press-

ure, the evidence was very contradictory; but it may be safe to add two other coincidences which seem to be established: the number of small comets about the sun seems to vary through a period about in agreement with that of the sun-spots; and it has been shown, particularly in photographs secured by Professor Schuster himself, that the appearance of the solar corona depends in some way on the same cycle.

Professor Schuster was followed by Mr. W. Lant Carpenter, who read a paper upon the same subject, prepared by Prof. B. Stewart and himself. It consisted, in the main, of a description of some very elegant methods which they had made use of in discussing the temperature observations of Toronto and Kew, for the purpose of detecting short periods common to solar and terrestrial phenomena. One of the results of this investigation was to show, that, in general, temperature phases make their appearance at Toronto eight days before they appear at Kew; while what might be called 'magnetic declination range weather' travels from Toronto to Kew in about one and six-tenths days.

The subject was further discussed by several members of the section, among whom was Rev. S. J. Perry, who took a very conservative view of the matter, and declared that much research was demanded before any thing really definite would be known.

The sun, at least as to its spectrum, received further attention from Professor Rowland and Rev. S. J. Perry, — the former exciting great interest in the section by an exhibition of several of his latest spectrum photographs, and a discussion of the remarkable advances in this direction which had followed, necessarily, the use of his diffraction gratings. Mr. Perry's paper was a discussion of observations on the spot spectrum from D to B.

Professor Carpmael described a new form of induction inclinometer which he had devised, which was a modified form of Lloyd's instrument, a bifilar suspension being substituted for an unifilar, and one or two other changes made. The instrument had only been in use a few weeks, but it promised to be of considerable value.

The Earl of Rosse described his method and machinery used for polishing specula, and with which he had completed at Parsonstown a three-foot and a six-foot speculum. He also described a device for securing electrical control of an equatorial driving-clock, which he had recently tried, and found to be very satisfactory. It was essentially a 'see-saw' escapement, with a piece of soft iron on an extension at one end, which moved between two electro-magnets, being held firmly by each, during a certain portion of the swing of the controlling pendulum. In this way, he had secured accuracy and certainty of control, even with crude apparatus.

Mr. Perry, in speaking of the great importance of accurate control of an equatorial, now that the spectroscope had come so to the front, said that it was interesting to know that Mr. Huggins, in producing some of the most perfect telescopic photographs that had yet been made, had not especially felt the need of a more perfect controlling device; since Mrs. Huggins was constantly at his side to regulate the position of the instrument, and that his splendid results were largely due to her precision and patience.

One of the most interesting and novel papers was that of Professor Douglass Archibald, describing his method of sending anemometers into the air by means of kites, and thus studying the velocity of the air at different heights. The carrying kite was seven feet in length; and this was raised and afterward somewhat steadied by a smaller one about four feet long attached to it. The anemometers were arranged at different points along the line of the larger kite, so as to record the velocity at various heights, in some cases extending up as high as six hundred feet. Although the experiments thus far made were only preliminary in their character, some interesting results had been obtained. The velocity increased with increased height, but at a diminishing rate. On being questioned, Professor Archibald declared that the most important thing about a kite was its tail. In his kite the tail was made up of cones of canvas arranged with their bases towards the wind, with the cord running along their axes. They were placed at a distance of three or four feet from each other, and six were used. Sir William Thomson said that after more than a century the kite was again being dedicated to science, first on one continent, and now on another. He was convinced that the device of Professor Archibald was sure to prove to be of great value in meteorological research.

Professor Archibald made a brief reference to the work already accomplished by a committee, of which he was a member, known as the 'Krakatoa committee.' Their object was to determine, if possible, whether the sun-glows or remarkable sunsets of the past year could in any way be attributed to the general diffusion of dust from the eruption of that volcano. They had succeeded in collecting much information, which had not yet been examined; and he could only say that nothing had yet appeared which was inconsistent with the Krakatoa theory.

Some further contributions to meteorology were made in a paper by Professor James Thomson on whirlwinds and waterspouts; in a note on internal earth temperature by Mr. H. S. Poole, in which the increase in temperature at Wolfville, N.S., was shown to be in fair agreement with other well-known determinations; and in a paper by Dr. H. Muirhead on the formation of mackerel sky. The latter was an extension of the explanation suggested many years ago by Sir William Thomson, by the introduction of a third stratum of moving air. The effect of one stratum moving over another, as Sir William Thomson had suggested, would be to produce 'waves' in the air, which might result in long lines of cloud-forms. A third stratum, moving in a direction at or near a right angle to the first, would tend to break these lines up into small patches, thus producing the peculiar appearance known as the mackerel sky.

Prof. Chandler Roberts interested the section greatly in presenting the results of some experiments which he had carried out to show the diffusion of metals; the cases specially considered being the dif-

fusion of gold, silver, and platinum in lead. The rate of diffusion in these cases, and notably in the case of gold, seems to be enormously high compared with the rate of diffusion in liquids.

Mr. W. J. Millar read a paper on iron and other metals in a liquid and solid state, which started a lively and entertaining discussion of the question of the expansion of iron on solidification. Mr. Millar contended that iron did not expand on solidification; while Sir William Thomson, and other members of the section, protested that Mr. Millar's own experiments proved conclusively that it did.

The matter of the velocity of light of different colors was considered by Professor Michelson, and also by Professor George Forbes. Mr. Michelson explained, somewhat in detail, his method of determining the velocity of light, and gave the results of an investigation of the velocity of red and blue through a column of carbon bisulphide about ten feet long. The velocity of the mean ray through this medium had been found to be about 1.75 times its value in air, which was somewhat higher than theory would indicate; but the difference was doubtless attributable to errors in experiment. A measurable difference between the velocity of the red and that of the blue ray had been observed, agreeing very closely with that indicated by theory. Professor Forbes's paper was a discussion of the observations by means of which he, in junction with Mr. Young, had shown, apparently, that there was a measurable difference between the velocities of red and blue light in air. The paper was discussed by Sir William Thomson, Lord Rayleigh, Professor Newcomb, Professor Michelson, and several others; and the general opinion was quite decidedly against the view that such difference really existed.

On the last day of the session, the section was divided; and a number of papers on pure mathematics occupied the attention of a sub-section. No report of these papers can be made, as the *Science* reporter found it impossible to organize a sub-section to follow the mathematicians.

PROCEEDINGS OF THE SECTION OF CHEMICAL SCIENCE.

THE session opened at noon, Aug. 28, with the president, Sir Henry E. Roscoe, in the chair. Dr. Perkins, the retiring president, sat on his right hand; and Drs. Wolcott Gibbs, Gladstone, and Frankland, on his left. The room was filled to overflowing; and the address was listened to with marked attention and interest, and the comments upon it were uniform in their commendation. This is rather surprising when we recall the present state of feeling in England which the efforts to found a superior institution for technical instruction have aroused, but his views on chemical education are in conformity with those generally entertained in the United States. It will be seen by the papers presented at this session, that the particular phases of the recent advances in chemistry of which the president treated occupy at present the attention of many of the English chemists.

The first paper read was by Dr. Wolcott Gibbs, at the request of the section, and was upon the complex inorganic acids. It consisted of a *résumé* of the magnificent work which he has done in the field which he has discovered and explored.

It is impossible in the brief space at our command to do justice to this superb research; which is destined to revolutionize many of our chemical conceptions, and in which has been shown the cumulative power of the molybdenum and tungsten oxides, the existence of dominant and subdominant groups, and of different kinds of basicity prevailing within the same molecule, and of the production of isomerism by the orientation of the atoms.

Mr. H. B. Dixon exhibited tables in which Bunsen's, Horstmann's, and his own results on the effect of mass on the incomplete combustion of mixtures of carbon monoxide, hydrogen, and oxygen were compared; and the discrepancies were found to be due to differences in the temperature and pressure under which the experiments were conducted. Above four hundred millimetres, the pressure did not affect the results; and at temperatures between 60° and 140° constant results were also obtained. It is believed, that when the mixtures were exploded below 60°, the reaction was interfered with by the condensation of water on the sides of the tube. Further, it was found that mixtures of carbon monoxide and oxygen, in equivalent proportions, could not be exploded unless there were aqueous vapor, or some body containing hydrogen, present. With traces of hydrogen, hydrochloric acid, hydrogen sulphide, or a hydrocarbon present, the mixture could be exploded. It is supposed that the steam is reduced by the carbon monoxide, and that the liberated hydrogen burns, and re-forms steam, which again acts on more carbon monoxide. By a series of alternate reductions, a few molecules of steam serve to carry oxygen to the carbon monoxide just as the oxide of nitrogen acts in the sulphuric-acid chamber. By putting a dry mixture of carbon disulphide and oxygen into a dry mixture of carbon monoxide and oxygen, the first could be inflamed, then by introducing a little water the carbon monoxide and oxygen could be exploded.

Professors Liveing and Dewar read a paper on the spectral lines of the metals developed by exploding gases. Berthelot has recently investigated, by means of the chronograph, the rate of propagation of the explosion of mixtures of oxygen with hydrogen and other gases; and has found, that, with a mixture of hydrogen and oxygen in the proportion to form water, the explosion progresses along a tube at the rate of 2,841 metres per second, a number which is not far from the velocity of mean square for hydrogen particles, on the dynamic theory of gases, at a temperature of 2,000°.

This velocity, though far short of the velocity of light, bears a ratio to it which cannot be called insensible. It is, in fact, about $\frac{1}{105000}$ part of it. Hence, if the explosion were advancing towards the eye, the waves of light would proceed from a series of

particles lit up in succession at this rate. This would be equivalent to a shortening of the wave-length of light by about $\frac{1}{100000}$ part; and, in the case of the yellow sodium lines, would produce a shift of a distance of about $\frac{1}{100}$ of the space between the two lines. It would require an instrument of very high diffusive power and sharply defined lines to make such a displacement appreciable. With lines of longer wave-length, the displacement would be proportionately greater; while, if a receding explosion could be observed simultaneously with an advancing one, the relative shift would be doubled. In this way the two images of the red lithium line would be separated by about $\frac{1}{3}$ of a unit of Angström's scale, a distance about equal to that between the components of the less refrangible of the pair of E lines.

The experiments were made first in a straight glass tube, and then in a U tube, which enabled them to observe the advancing and retreating wave. In these cases it was found that the calcium spectrum was produced, owing to particles of the glass detached by the explosive reaction. The reversals showed too, that, in the wave of explosion, the gases do not reach their maximum temperatures all at once, but the front of the wave is cooler than the part which follows and absorbs some of its radiations, while the rear of the wave does not produce the same effect.

Experiments were now made in iron tubes, and here the spectrum of iron was obtained from the particles detached from the tube. Altogether, sixty-eight lines of iron were identified, of which about forty lie in the ultra-violet between hydrogen and oxygen. Only one iron line above oxygen was definitely seen, and that in only a few photographs. Since iron gave so many lines, linings of copper, lead, cadmium, zinc, aluminium, and tin were inserted in the tube. Cadmium, aluminium, and tin gave no lines whatever; zinc gave only a doubtful impression; lead gave one visible line, and two in the ultra-violet; copper gave one visible line in the green, two in the ultra-violet, and occasionally a shaded band in the blue; cobalt and nickel gave a great many lines. Berthelot and Vielle having put the temperature produced by the explosion of hydrogen and oxygen under a pressure of 9.8 atmospheres at 3,240°, the authors believe that they cannot be far wrong in assuming the temperature at about 3,000°, and that at this temperature such metals as iron, nickel, and cobalt are vaporous, and emit many characteristic rays, and that by far the greatest part of these rays lie between G and P.

The discussion on the constitution of the elements was opened by Dr. Dewar; and after referring to the doctrine of continuity found in the essays of Grove, taught by Black, and held by Newton, and the views of Clerk Maxwell who said that the process by which atoms are formed cannot be known, since they are neither born nor do they die, he stated that our recent knowledge on the constitution of molecules was largely due to the studies of Deville upon dissociation, and that he was led to make these studies from the observation of Grove that a platinum bead heated in an oxyhydrogen flame would decompose water when immersed in it. Experiments made by Dr. Dewar in this direction were described; and it was stated that chemical bodies are not fixed or unstable at certain fixed temperatures, but that there exists a relation between the pressure, temperature, and character of the body, which determined its stability. Deville held the change to be similar to a change in state of bodies; and, this relation being true, thermodynamics enable us to determine the amount of change for given conditions. The change of state in elementary substances is not unlike a chemical change.

The spectroscope has been used to study the constitution of molecules, and Roscoe has found that the allotropic forms of bodies give different spectra. Lockyer has attempted to show the evolution of the elementary bodies from hydrogen. His results have been criticised as having been due to the presence of impurities, but Lockyer disproved this. It has been said, too, that he did not use a spectroscope of sufficiently dispersive power.

Prout's hypothesis was next considered; and it was shown that the most careful determinations of the atomic weights of nitrogen, potassium, magnesium, zinc, and bismuth, by Stas and Marignac, yielded results that were not simple multiples of hydrogen.

In continuing the discussion, Dr. Gibbs said he was not sure that the accepted views of the molecular constitution of chemical compounds was the correct one. Taking common salt, for instance, it might in the solid state be composed of one hundred molecules of sodium and one hundred molecules of chlorine; when in solution it might be simpler; when in the gaseous form, simpler still; and when exposed to a vacuum, such as Mr. Crookes has produced, it might have the accepted constitution. He referred to the fact, that Professors Liveing and Dewar had found that cadmium, mercury, and zinc gave no spectra at high temperatures. As these are all monatomic molecules, it might be that in this process we possessed a means for studying the constitution of the elementary molecules. Professor Liveing thought Dr. Gibbs's suggestion concerning the action of the monatomic elements an improbable one, since aluminium and tin gave no lines under the same conditions. He said that many lines of iron suggested either a very complex constitution, or else that the substance we term iron is really formed of a number of elements which yet defy separation, and which have nearly similar atomic weights. We have an instance of such a case in the cerium group. The D_3 line, for instance, may belong to an element more volatile than hydrogen. Sir Lyon Playfair pointed out, that when solid iodine was immersed in liquid sulphurous acid no action resulted; but if the iodine was in solution, and the sulphurous acid gaseous, they combined readily. He suggested the study of the temperature at which iodine or sulphur would combine with sulphurous acid. Dr. Tilden said we needed more extensive and accurate observations on the temperature at which chemical action — such, for instance, as the point of ignition — begins. Dr. Dewar stated that we have, in the result of the researches of Dr. Perkins in the magnetic rotation of

compounds in relation to their chemical composition, a means for determining molecular weights by optical methods.

The reports of the committees on spectrum analysis and on chemical nomenclature will be published in full, in the annual report of the association.

A paper was next read on some phenomena of solution illustrated by the cases of sodium sulphate by William A. Tilden. In a recent paper in the Philosophical transactions, the author has favored the theory which ascribes solution, not to any combination, chemical or otherwise, of the solid with the solvent, but to liquefaction arising from the mechanical or kinetic action of the molecules of the liquid in which the solid is immersed. This theory is now being tested through a study of the thermal phenomena attending the solution of sodium sulphate.

Crystallized sodium sulphate containing ten molecules of water melts at 33°-34°. At 34° or thereabouts it begins to show signs of dissociation. The maximum point of solubility likewise is at this temperature. In consideration of these facts, Professor Tilden propounds the query: In what condition is the dissolved salt at temperatures above 33°? Is it in the form of the usual hydrate, or is it wholly or in part in the anhydrous state? The diminished solubility is believed to indicate progressive dissociation; but, this view being questioned, the heat of solutions at temperatures above and below the critical temperature is being determined. The data given, although subject to some slight revision, show that at temperatures as high as 55° the thermal change is still positive, although a diminishing quantity; and hence, that the act of solution is still attended at these temperatures by a chemical combination between the salt and a portion of the water. In this connection, Professor Tilden presented a modified form of calorimeter used in his experiments.

W. W. J. Nicol next presented a theory of solution. The theory proposed is, that the solution of a salt in water is a consequence of the attraction of the molecules of water for a molecule of salt, exceeding the attraction of the molecules of salt for one another. It follows, then, that, as the number of dissolved salt molecules increases, the attraction of the dissimilar molecules is more and more balanced by the attraction of the similar molecules: when these two forces are in equilibrium, saturation takes place. At the saturation point the force tending to keep in solution any single molecule of salt (attraction of dissimilar molecules) is balanced by the force tending to produce separation of that molecule from the solution (attraction of similar molecules). Further, any external cause tending to alter the intensity of either of these two forces, or to modify both in unequal degrees, disturbs the condition of equilibrium, and further solution or solidification ensues. The above theory is based on the molecular theory of liquids, and has many points in common with that of Dassios proposed in 1866.

In putting this theory to the test of experiment, certain results followed which in such a brief note as this cannot be mentioned.

Mr. Nicol lays stress upon the fact that he expresses the value of a salt solution by n molecules (equivalents) of salt to one hundred molecules of water; and he holds that the experiments made on the continent are valueless where they have been made by dissolving one, two, or more molecules of salt in a litre of solution, since, as the molecular volumes of the salts in solution vary, the solutions are not similar as supposed.

A paper followed on evaporation and dissociation, by Professor William Ramsay, and Sydney Young. It having been suggested, that the closer proximity of molecules in the liquid and solid state may be due to the coalescing of two or more gaseous molecules, to form a complex molecule, the authors hold that the work done in dissociating these complex molecules into single molecules is analogous to that expended in converting a solid or liquid into gas, and that the same relations between the existing temperature and pressure would exist. The temperature of volatilization of a large number of solids was determined by the 'cage' described by them before the Royal society, April, 1884. With bodies like phthalic and succinic acids, this relation was found to exist; but with acetic acid little or no dissociation was discovered. Also a distinct difference was observed in the behavior of dissociating substances in the liquid and solid states when evaporating from a full surface. So long as a substance is solid, the residue retains its original composition, but a liquid separates into its components: this amounts to a proof that a solid in volatilizing does not pass through the liquid state, and that so long as a substance remains solid it cannot dissociate. The results obtained lead the authors to provisionally doubt the existence of complex molecular groups in liquids.

The object sought in Professor William Ramsay's paper on molecular volumes was to ascertain whether the boiling-points of compounds, under equal pressures, really afford suitable points for a comparison of the molecular volumes. The experiments made decisively show that in methyl, ethyl, propyl, isopropyl, and isobutyl alcohols, and ether, the value of the group CH_2 is by no means constant: while at the boiling-points of the liquids at low pressures, the value is approximately constant, fluctuating between 17.5 and 22, at high temperatures the difference becomes much more apparent, attaining at pressures of 20,000 mm. (which was the highest measured) the greatest irregularity.

Professors Goodwin and Marshall are studying the solubility of chlorine gas in solutions of metallic chlorides; and finding that other experimenters have been observing the expansion of solutions made by dissolving n molecules of the salt in m molecules of water, and that consequently these contain, when diluted, neither the same number of molecules of the salt nor of the water, they have arranged their experiments so that this ratio shall remain constant throughout the observations.

Sir H. E. Roscoe, speaking in regard to the diamantiferous deposits of South Africa and the ash of the diamond, showed that silica and iron oxide form

constant constituents of the diamond. It is a curious fact, that when these yellow diamonds are heated out of contact with the air they lose their color, and remain colorless so long as they are not exposed to the light: then they immediately regain it.

A discussion on chemical changes in their relation to micro-organisms was opened by Professor Frankland. He stated that contact action had been held to be of two kinds, — that where both of the bodies underwent a change, and that in which one of the bodies remained unchanged. The last was called catalytic action. The changes taking place in organized bodies had been referred to the last class, but organic chemistry had proved them to belong to the first. In organized bodies, both analytical and synthetical changes take place; but in general the first take place in the bodies of animals, and the last in vegetables. This enables us to determine to which of the two kingdoms a body belongs, and judged by this criterion the microcosms belong to the animal kingdom. Soluble ferments, on the contrary, act by contact without giving of themselves. The changes which these soluble ferments produce were then shown in a series of tables; and it was seen that the resulting analytical reactions were usually quite simple, but were attended by the evolution of heat. Referring to this point, it was suggested, that as allotropic and isomeric changes often convert potential into kinetic energy, it might be possible to maintain life through these changes. The reactions produced by the micro-organisms were next shown in a series of charts, together with illustrations of their forms. The reactions in these cases were far less simple; but in some instances, as with the Saccharomyces cerevisiae, it is a question how far the by-products are due to the action of the micro-organism. The power of these organisms to resist chemical substances generally and high temperatures was shown, yet spongy iron quite destroyed them. It is of the utmost importance to discover some simple agent for destroying these bodies, which is harmless to man.

In discussing this topic, Professor Roscoe pointed out the fact that one ferment produces only one reaction, and that this was probably true in those more complicated reactions which attend disease. Dr. Dallinger stated that he was able by slow stages to so change the environment of a micro-organism, that eventually it lived under conditions entirely unlike its natural ones, and that he had cultivated the most highly organized ones in solutions which contained no organic matter whatever. Dr. Dewar called attention to the wonderful preservative power of hydrogen peroxide. One one-hundredth of one per cent will preserve urea indefinitely. It does not, however, preserve milk indefinitely, on account of the physical action of the milk globules, while it has no action whatever on the soluble ferments. He believes the heat evolved by the action of the ferments to be due to the hydration of the alcohol; and he pointed out that we have in bacteria the most delicate agent we now possess for detecting oxygen, and the most accurate for measuring light.

Sir John Lawes and Dr. Gilbert presented a paper on some points in the composition of soils. This was a continuation of the paper presented to the American association two years ago; and it is sought to show that the view which has been maintained, that a soil is a laboratory and not a mine, is erroneous; for not only the facts adduced by the authors in this and other papers, but the whole history of agriculture so far as we know it, clearly show that a fertile soil is one which has accumulated within it the residue of ages of previous vegetation, and that it becomes less fertile as this residue is exhausted. The results of many analyses and experiments with the soils of Manitoba and other prairie lands were cited in evidence.

PROCEEDINGS OF THE SECTION OF GEOLOGY.

It is impossible, in the limited space at our disposal, to do any thing like justice to the large number of interesting papers presented to this section, and to the discussions called out by them. Moreover, coming prominently before the section as there did, such questions as glacial action, causes of the ice age, formation of the basins of the great lakes, the origin of coal, metamorphism, and the many questions connected with the archean rocks, and when these questions were discussed by men like Dawson, Hall, Geikie, Newberry, Hunt, Bonney, and by many younger though no less earnest workers in geology, it is easier to imagine than to describe in detail the interest attached to such an occasion.

The number of papers presented — fifty-one — was too large to admit of satisfactory discussion; and, even hurried over as they were, it was necessary for the section to meet again upon a fifth day, instead of completing its work in four sittings as was originally anticipated. Many of the topics presented were passed over so lightly as rather to discourage the presentation of papers containing the results of long and patient labor. Even the important questions treated of by Dr. Blanford in his opening address were lost sight of except as he occasionally called them to mind.

While the discussions were sufficiently animated, — some of them perhaps even more so than was seemly, — the animation was due, to a considerable extent, to the tenacity with which each one held to his own theories, rather than to any considerable array of facts brought forward to sustain them.

The section met in the lecture-room of the Redpath museum. A full audience heard the address of Dr. Blanford the chairman, and toward the close of its delivery Lord Lansdowne was one of the listeners.

At the close of the address, in accordance with English usages, a vote of thanks to the speaker was proposed by Sir William Dawson, who commended Dr. Blanford's presenting a subject so full of debatable matter as likely to excite the greatest interest and discussion. Seconding the motion, Dr. Selwyn, director of the Geological survey of Canada, referred to instances similar to those mentioned, which occur in Vancouver's Island and in parts of Australia not re-

ferred to in the address by the chair. The general impression made by the address seemed to be that the problems presented were not only important ones, but too much so to admit of much discussion here, and that they can be solved only by a large amount of observation and field-work.

The ten papers presented during the first day's session, with one exception, related to the geology of the dominion.

The paper of Mr. Gilpin upon gold-mining in Nova Scotia, that of Mr. Brown upon the apatite deposits of Quebec, and that of Mr. Merritt upon the localities and output of economic minerals in Canada, were more or less statistical, and, although important in themselves, did not admit of much discussion.

A short paper by Mr. Frank Adams of the Geological survey of Canada, upon the occurrence of Norwegian 'apatitbringer' in Canada, and its associated minerals, although upon a subject mineralogical rather than geological, was a valuable contribution in itself, and drew forth an interesting discussion by Dr. G. H. Williams of Johns Hopkins University. Recent studies of optical anomalies seen in many minerals seem to show that not a few substances have different crystalline forms at different temperatures. One of these, pyroxene, has a tendency to pass into hornblende when the temperature is lowered. Nature may accomplish the same thing by pressure. Such changes have been observed by Dr. Williams in certain rocks in Maryland and New York, where schistose structure and these changes appear to be co-extensive.

Mr. Honeyman's paper upon the geology of Halifax Harbor was strongly dissented from by Dr. Selwyn, supported by Professor Hitchcock, who insisted that the rocks at that locality were lower Cambrian, and not archean as stated, except perhaps in isolated masses.

The coal-fields of the dominion were treated of directly and indirectly by Mr. Bailey of the Canadian survey on the Acadian basin in American geology, Mr. Gilpin on the distinctive features of the Nova Scotian coal-field, and by Mr. Budden on the coals of Canada.

The Acadian basin borders upon and includes the Gulf of St. Lawrence, New Brunswick, Nova Scotia, Newfoundland, and Prince Edward Island, dipping on all sides toward the gulf. Within this great basin, the most important coal-fields are those of Cumberland, Pictou, and Cape Breton. The beds are more or less folded; the axes of the folds are east-west; and, except where they have been complicated with older strata, there are no serious faults. Differences between districts within this great basin are probably due to local influences in the original basin, rather than to isolation. Attention was called by Dr. Selwyn to the contrast between this broken region and the less-disturbed country adjoining it to the west and north-west, which he considered was due to the limiting of the disturbances by the great St. Lawrence and Champlain fault. This fault is supposed to follow up the St. Lawrence River from somewhere in the gulf, to Quebec, where it leaves the stream, and swings more strongly to the south, and passes down Lake Champlain to somewhere in the vicinity of the Hudson River. To the east of this great fault, the rocks are metamorphosed, folded and broken, while to the west they are but slightly disturbed, and dip at low angles. Besides the coal-fields occurring in the St. Lawrence basin, the two other localities within the dominion producing coal were referred to; one extending from the 97th parallel to the base of the Rocky Mountains, the other on Vancouver's Island. Of the three fields, the first is in the carboniferous, while the last two belong to the secondary or tertiary formations. But little is known as yet of the coal of north-west British Columbia, while that of Vancouver's Island is said to be the best on the west coast.

Mr. Panton's contribution upon the Silurian strata of Red River Valley, Manitoba, was of local interest, and referred to a structure that is not indicated upon the new geological map of the dominion, for want of sufficient information. The same material is already in the hands of the Canadian survey, and will appear in due time.

The principal discussion of the first day's meeting was called forth by Professor Claypole's paper upon the crumpling of the earth's crust as shown by a section across Huntingdon, Juniata, and Perry counties in Pennsylvania, a distance of sixty-five miles. The speaker showed that the folding of the strata along this line, and especially of those in Cumberland valley, has caused a shortening from an original length of about one hundred miles to the present sixty-five miles. Although Professor Claypole's method of obtaining the original length of this line was a mathematical one, and though the folding of the Cumberland-valley strata is a series of overturns, such an extensive contraction of the earth's crust was more than the section was prepared to accept without question. Doubt was expressed in regard to the trustworthiness of the data; while another member, in endeavoring to solve this very problem, basing his estimates upon Professor Lesley's maps, had computed a contraction of eighteen miles over a part of the section where Professor Claypole had made out thirty-two. It was also suggested that the thinning of the beds by crushing in the folded parts had been left out of account.

It was replied to these objections, that the data were as trustworthy as it was possible to obtain; that absolute accuracy was not claimed for the figures, for in such a case it was impossible; and that, at the least estimate, the eighteen miles remained to be accounted for over one part of the section line. The possible thinning of the beds had been left out of account, because, if such a thing had taken place in this instance, it was more than counterbalanced by the tangential pressure that caused the folding.

The 29th was devoted to the discussion of phenomena relating to, and supposed to be the results of, glacial action. Professor Lewis spoke upon the marginal kames of Pennsylvania as distinguished from the moraine; and Dr. Newberry followed with a short lecture upon the last phases in the evolution of the

North American continent. He pointed out the evidences of a genial climate at the close of the miocene and pliocene, which were soon followed by the age of ice; traced the southern limit of the ice-sheet across the continent as far as it has been observed, and expressed his belief in two glacial periods.

These papers were discussed together. Professor James Geikie was unable to draw any sharp line separating moraines and kames, for they merge into each other in such a manner that one cannot say where one leaves off and the other begins. Kames he regarded as partly morainic, and partly of subglacial origin; and he was in accord with Dr. Newberry in regard to the break in the glacial period. Sir William Dawson was inclined to think that water was largely instrumental in producing the work attributed to ice, and referred to the evidences in eastern North America, of the warm interval during the ice age. Dr. Selwyn briefly proposed a possible explanation of the supposed power of ice to excavate, in solid rocks, basins like those of the great lakes. He referred to the profound decomposition of rocks observed in Australia and in the gneiss of Brazil. In Australia this decomposition was sometimes two hundred and fifty feet deep; and he thought it possible that ice, entering such a region, would be able to make such basins as those of the great lakes. Professor Spencer, of the university of Missouri, contributed some of the results of his own work upon the subject of the origin of the basin of Lake Ontario, which led him to believe that this lake basin, at least, was not of glacial origin. Professor Hall of New York called attention to the fact that the axes of the lakes are along the lines of outcrop of the rocks, and that the basins are excavated in the softer material.

Four other contributions, relating in one way or another to the glacial period, were read without much discussion; and the theories concerning the causes of the ice age were taken up. The Rev. Mr. Hill classed the theories as cosmical, terrestrial, and astronomical. The first class was not regarded as worthy of consideration, while terrestrial theories were as readily disposed of as being more or less unsatisfactory. Attention was directed especially to the theory of Dr. Croll, a combination of the precession and eccentricity theories. It was held that the part of Croll's explanations regarding fogs, deflection of currents, and the like, would support any or all theories alike. His conclusion was, that the alteration of currents and winds seemed to be the most powerful causes thus far suggested.

That part of Croll's theory regarding the greater eccentricity of the earth's orbit was attacked by Mr. W. F. Stanley in another paper. He could not conceive of the earth's initial temperature having been lower, or of the sun's heating power being less, and that therefore glaciation could not have depended upon such conditions. He regarded it as a local phenomenon, due to aërial and oceanic currents.

There was no session on the 30th, the day being given over to excursions. To the English geologists the occasion was a welcome one; and under the guidance of members of the geological survey of Canada, and of the local committee, they visited Ottawa, Ausable Chasm, Lake Memphremagog, Quebec, and various localities in the immediate vicinity of Montreal.

The prominent questions coming before the section on the 1st were those regarding archaean rocks. Professor Bonney opened the question with a lengthy paper upon these rocks in England, and made some comparisons with those of Canada. Dr. T. Sterry Hunt followed, treating of the eozoic rocks of North America. The paper was a *résumé* of some of Dr. Hunt's old work. As might have been expected, the very use of the word 'eozoic' was followed by some shaking of the head among the members; and, at the close of Dr. Hunt's reading, the use of the word was criticised as taking for granted a question which is still in dispute. The writer held, however, that his use of the word did not depend solely upon whether the supposed Eozoon canadense were the remains of a living organism, but upon the evidences of organic life having come into existence at or about the geological age referred to.

Professor Hall discussed the question at some length, and expressed the conviction that the solution of the problem lay in the study, not of large masses of rock, but in the study of junctures.

Every one was interested to hear what Sir William Dawson would say upon this question. He appeared to speak with some hesitation, due doubtless to the opposition to his well-known theories. He had but little to say; urging as a reason, that he was but poorly qualified to discuss the question from the standpoint from which it was being viewed, — namely, that of a chemical geologist. He said that he had spent his time in trying to find fossils in these rocks, and had got but little thanks for his labor. He would not enter the question in regard to Eozoon here. A co-laborer has the whole matter in hand now, and will soon publish all that is known. Major Powell was called upon, but limited himself to saying that we were not much disturbed by the question in the States, but were limiting ourselves to mapping the regions covered by these archean rocks.

The paper by Prof. J. D. Dana upon the southward ending of a great synclinal in the Taconic range was read by Professor Brewer, and elicited some very heated and severe protests on the part of Dr. Hunt. He insisted that the structure referred to was known twenty years ago, that the metamorphosis of sedimentary beds assumed by Professor Dana was untenable, and that there was no vestige of a proof of such a thing. Professor Brewer replied in behalf of Professor Dana, that recent and thorough work had been done in the region referred to, and that nothing was stated upon assumption. Major Powell was astounded that Dr. Hunt should speak as he did, if the structure was as represented; and he called upon him to either give his reasons for such statements, or to retract them, for the only way to attack such a question was to attack the structure. Professor Hall opposed Dr. Hunt's position, and vouched for the structure as represented; and Dr. Selwyn spoke of the existence in British Columbia of crystalline rocks in the carbon-

iferous. Mr. Topley of the English survey then spoke of the general acceptance, by the various European surveys, of the theory of the change of sedimentary to crystalline rocks; and here the discussion of the archean rocks ended.

Members of the English survey exhibited maps colored so as to represent the solid geology; and others, of the same places showing the geology as it is actually seen upon the surface, that is, including the drift. This latter was regarded as valuable in connection with questions of water supply. Doubt was expressed, however, about the value of such surface maps save for local and temporary purposes, and it was suggested that some method be devised by which it would be possible to represent both solid and surface geology upon the same sheet.

The plan of Mr. Gilbert, of the U. S. geological survey, for a subject bibliography of North American geology, elicited some discussion. The section evidently felt a deeper interest in this paper than it was ready to express on so short a notice.

A brief account of his work upon the Jurassic mammals of America was given by Professor Marsh. Six years ago no Jurassic mammal was known; but five years ago they were found in Wyoming, and from one pocket alone from three to four hundred individuals have been taken, representing eight genera and twenty species.

Sir William Dawson spoke at some length upon the ancient land flora of the old and new world, calling attention to the striking correspondence found in countries widely separated.

Two paleontological papers by Mr. G. F. Mathews were spoken of in high terms, especially by the Canadian geologists; and the hope was expressed, that if, as had been suggested, one of the Canadian papers should be published in full by the association, the one upon the primitive Conocoryphean should be selected.

A paper by Prof. J. Milne, upon the earthquake phenomena in Japan, referred to the mechanical difficulties to be dealt with in his observations, and described a new earthquake house he has built upon large balls resting upon iron plates. Three hundred and eighty-seven earthquakes had been observed by him, eighty-seven per cent of which came from the sea.

Sir William Dawson then went over the leading facts worked out by Dr. Hall in his forthcoming geology of Palestine.

The last paper presented was by Mr. P. Hallett, and consisted of notes on Niagara Falls. For American geologists they contained nothing new.

It will be seen that nothing striking or new was presented to the section; indeed, some of the productions have been served up already a number of times and in various forms. But any thing different was hardly to be expected. The meeting was remarkable for bringing together workers in geology from every quarter of the globe. From Japan was Lyman, and a paper was read from Milne; from India were Blanford and Ball; from Australia were Blanford and Selwyn; from Africa was T. Rupert Jones; from Palestine was Professor Bauerman, and a paper was read from Hull; from Brazil was Branner; from England, Scotland, and Ireland, were the various members from those countries; from the States were Hall, Newberry, Marsh, Powell, and many others; while the Canadian workers were represented by Dawson, Selwyn, Whiteaves, and Adams.

PROCEEDINGS OF THE SECTION OF BIOLOGY.

IN opening the biological section Thursday, Aug. 28, the president of that section, Prof. H. N. Moseley, delivered an address upon the physiology of deep-sea life. Well fitted as Professor Moseley is to discuss the subject of deep-sea life, on account of his long participation in its investigation during the voyage of the Challenger, his address was not only a critical and discriminating review of some of the later results arrived at by other observers and experimenters, but was supplemented by many valuable statements and suggestions of his own.

Mr. C. Spence Bate, of Plymouth, Eng., read a paper on the geographical distribution of the macrurous Crustacea, which embodied many important notes on form, color, habits, and habitats of different genera of these animals. In allusion to points mentioned by Mr. Bate, Professor Moseley said that deep-sea forms either had very large eyes or had no eyes, and that there must be a source of light in the deep sea; that source was phosphorescence, but its light must be very dim. The question was still unanswered, whether the larvae of deep-sea crustacea were found at the surface, as are the larvae of other crustaceans, and had to descend two or three miles through the ocean to reach their feeding grounds as adults.

Prof. W. J. Sollas, of Dublin, read a long paper on the origin of fresh-water faunas. The main difficulties in the way of most marine animals becoming inhabitants of fresh water were considered under three different heads: first, the time requisite for the animals to adapt themselves to the new medium; second, the greater severity of climate experienced by animals in fresh water than in salt water; and, third, the inability of marine animals with free-swimming larval stages to enter the mouths of fresh-water streams, or to breed in flowing streams if they gained access to them. In regard to climate, it is a fact that many marine forms become fresh-water ones as we approach the tropics. But severity of the climate of fresh water is not alone sufficient to account for the absence from it of many families well represented in marine faunas. Professor Sollas had prepared an extensive table, comparing by orders and by families the animals of fresh with those of salt water, and finds as a rule, with some exceptions, which he accounts for by peculiarities of life-history, that fresh-water animals carry their ova in or about them during the earlier stages of development, or they develop by buds or statoblasts. Some marine forms have passed from the ocean into marshes, and

e into streams; while other forms, especially g earlier geological times, owe their transfer fresh water to the changing of marine into rine areas. Professor Sollas reviewed some of lations which the origin of certain fresh-water have to geological periods and changes, and lered some of the causes of modification of and of prolongation of embryonic life of marine als.

the succeeding days a few papers upon the geo-ical distribution of animals were presented. E. Dobson pointed out that many of the most cteristic species of the chiropterous fauna of alia have their nearest allies not in the Oriental the Ethiopian region, and instanced the pres-of species of certain genera of bats in Mada-r and Australia which were poorly or not at all ented in India. We are therefore obliged, for nd other reasons, to suppose, that, at a com-ively recent period, a chain of islands connected gascar with Australia; the islands being suffi-y far apart to prevent the distribution of ter-al mammals, yet near enough to permit the onal passage of flying species. Later, a tem-y connection of a similar kind probably ex-d between Madagascar and India. Treating aphical distribution of animals in a less general er, was a paper by Mr. Howard Saunders on ographical distribution of the Laridae (the gulls terns), with special reference to Canadian s.

to the distribution of plants, Professor Asa Gray, remarks on the characteristic features of North-ican vegetation, called attention to the resem-s and the differences between the flora of North ica and that of Europe, and to the causes of resemblances and differences. The similarity trees of the Atlantic border to those of Europe lluded to, and its cause discussed; and mention ade of the pleasure which the European botanist l experience in finding, in the new world, plants ng wild which are cultivated in the gardens of e. Among these are species of Rhododendron, pedium, and Coreopsis. Turning to the differ-between the flora of Europe and America, the h of species of trees and shrubs in the latter ry was illustrated by numerical comparisons of ecies of oaks and of many other trees in Canada those found in England. Besides the far more rous kinds of leguminous trees, and the remark-ealth in species of Compositae which is notice-n America, there are many tropical plants which d northward into the United States. Such are as trees, and Sarracenia, Passiflora, Tillandsia, numerous other herbaceous plants. After dis-n of the part which the ice of the glacial period d in the distribution of plants over Europe and America, Professor Gray reviewed the charac-cs of the flora of the middle and western por-of North America. This paper was one of the hich the general committee voted to print in its proceedings.

ately connected as it is with the question of the distribution of trees in the United States, attention may be called to the Jesup collection in the New-York museum of natural history, which was briefly described in a paper by Prof. A. S. Bickmore. This collection, besides illustrating the wood, bark, leaves, and other parts of the trees of the United States, by dried specimens or by figures, inside the museum, is supplemented by having the trees about the museum numbered to correspond with the specimens, so that immediate reference can be made to the museum by any one who wishes to learn more about a tree seen in the park.

On the question of the affinities of different groups of animals, as shown by their anatomy or development, several papers of importance were read; but of the greatest value was the announcement made in a brief telegram from Professor Liversedge, in Australia, announcing that Mr. W. H. Caldwell, who is in Australia in order to study the development of some of the curious animals found there, had discovered that the Monotremata are oviparous, and that the egg is meroblastic. No statement was given in the telegram as to whether the facts were determined as regards Ornithorhynchus or Echidna; but the main points of interest are the discovery of the oviparous habits of a mammal, and the meroblastic development of its egg, as in reptiles, since the eggs of mammals are regularly holoblastic. This shows that we must turn to the reptiles for the ancestors of the mammals.

Prof. O. C. Marsh read a paper on the classification and affinities of dinosaurian reptiles. It was replete with facts derived from the large amount of material which has been accumulated within the last half-dozen years. Three orders were recognizable in the herbivorous, and one order in the carnivorous dinosaurs. In the carnivorous groups we have forms with greatly enlarged pelvis, and animals that sat down. One of them which was found the past year, Ceratosaurus, exhibits new characters for a dinosaur. The vertebrae are smooth in front and concave behind. The pelvis is made up of three coössified bones, as it is in birds, and not of separate bones as in Archaeopteryx and in other dinosaurs. Ceratosaurus also agreed with adult birds in having the three metatarsal bones coössified. The dinosaurs are thus shown to be very closely related to birds; and, in answer to a question, Professor Marsh called attention to the correspondence between the double sternum of larger dinosaurs and the ossification of the sternum from two centres in young birds.

Prof. A. Milnes Marshall showed, in a paper on the mutual relation of the recent groups of echinoderms, that Carpenter was correct in regarding the central capsule with its radiating axial cords in Comatula as the central nervous system, while the subepithelial bands, which Ludwig and others have regarded to be the true nervous system, are, in reality, nervous in character, but of subordinate importance. Professor Marshall has proved these points by a series of conclusive experiments, which he conducted at Naples upon the living animals. In regard to the homologues of the parts of the nervous system of

equatorially, which had an objective of eight inches aperture, and a focal length of about forty-seven inches. The exposure was over five minutes.

The diameter of the sun is about three-eighths of an inch, and the coronal outline is in general quite thirty minutes from the sun's *limb*. Streamers extend more than twice this distance from the limb.

There is no great amount of detail in this picture, as was to be expected; and we shall look for the publication of the photographs of shorter exposure with interest.

One important fact is stated by M. Janssen; to wit, that, so far as his photographs have been examined, they show no trace of an intra-mercurial planet.

— Mr. Cochery, the French minister of posts and telegraphs, according to the *Science monthly*, reports to the French academy of sciences, that there were in France, during the first half of the year 1883 (from the beginning of January to the end of June), the following strokes of lightning. In January there was a stroke injuring a man who carried an open umbrella with metal ribs. In February there were no strokes at all. In March there were four strokes, damaging unprotected buildings and a high oak-tree. In April there were only four strokes, injuring several persons, some poplar trees, a weathercock, a bell-tower, and an isolated building. In May there were twenty-eight strokes, killing two men, seven cattle, three horses, and injuring several persons and two horses, as well as numerous trees and houses. The trees were oaks, chestnuts, poplars; and several of the strokes attacked the chimneys of the houses. It is notable that a gilt wooden figure of Christ in front of the church of Bonsecours (Seine inférieure) was struck, although the church has a lightning-rod on it. During the month of June the total number of strokes largely increased; there being no less than a hundred and thirteen, or from three to four a day. The daily number varied during the month, but was, if any thing, larger at the end than at the beginning of the month. Seven men were killed. About forty persons — men, women, and children — were injured. Some seventy animals were killed, including fifty sheep and a dog. Many trees, oaks, poplars, elms, firs, were struck. A common object struck is the bell of some church, the chimney of some house, or the weathercock of a barn. Some of the strokes were received by the lightning-rods of buildings, and did no harm, except, perhaps, fusing the point of the rod. On the other hand, several accidents to buildings, and in one case death to a horse, occurred within a comparatively short distance of a lightning-rod (from fifty to eighty metres). Isolated trees, and animals under them, appeared to have suffered most. Rain and hail accompanied most of the storms.

— Mr. Frederick John Smith writes to the *Electrical review* as follows: —

"Considerable trouble has been felt by those who are engaged in practical problems connected with secondary batteries, arising from imperfections in the cells for holding the dilute acid, and also from the fact that the plates of a charged secondary battery cannot be lifted out of the liquid, in order that any required area may be exposed to the action of the acid, without the rest of the reduced lead on the kathode plates being at once acted on by the oxygen of the air. To meet these difficulties, I have carried out the following methods: The cells are made of common pottery-ware about two centimetres thick. All sharp corners should be avoided in the moulding of the cells, because they do not stand the process of cooling well, while rounded corners seldom crack during cooling. These rough porous cells are warmed slowly in an oven, to such a temperature that paraffine-wax melts easily when rubbed against them. The cells, on being removed from the oven, are partly filled with paraffine-wax: this is made to run well over the whole inner surface of the cell. As soon as the wax begins to set, it is poured out, and the cell is put away to cool. A cell so made stands acid well; and the dilute acid does not creep up the sides of the cell, as it does in the common glazed cell. Another method, used at an earlier date than the one just mentioned, was to make deal boxes of the size required, and place inside them card-boxes (held out by sand), so that there was a space of about one centimetre between them. This space was filled with common paraffine-wax; then, the card-box being removed, a perfect lining of wax was left. This method is more costly than the last, but has the advantage of greater strength. The test of two years' constant use has shown that both these forms of secondary battery cells are both practical and lasting. When using a secondary battery in the laboratory, it would sometimes be convenient to be able to expose only some part of the plates to the action of the dilute acid; but, as things now are, this cannot be done without the part of the plates which are lifted out being at once acted on by the oxygen of the air. To prevent this action taking place, the plates are drawn out of the liquid into the vapor of benzol (after several experiments with different gases, this appeared to answer well, and to be easily managed). By this means the injurious action mentioned is prevented, and any required amount of surface of plate may be exposed to the action of the dilute acid."

— The *Revue scientifique* states, that, notwithstanding the ravages caused by the Phylloxera, France is the country which furnishes commerce with the greatest quantity of wine. Of the hundred and fifteen millions of hectolitres produced by Europe in 1881, France furnished thirty-four millions; while the average from Italy, Spain, and Austrian Hungary was only from twenty to twenty-five millions, and that of Germany, Portugal, Turkey, Greece, Roumania, and Switzerland, varied from four millions in Portugal, to one million in Switzerland. At present France supplies its lack of harvest by importing wines which it again exports, doctored, and mixed with its own. It receives wines especially from Spain, Italy, Portugal, and Greece. It treats the settlings, the residuum of the native harvest, with sugar, alcohol, and water, and thus makes wines known as the 'second vat.' It also makes wine of raisins received from neighboring high countries and from Syria. To the raisins, softened in water, sugar and alcohol are added, one kilogram of raisins yielding from three to four litres of a harmless wine. This manufacture is carried on especially at Marseilles, at Cette, at Bordeaux, and at Bercy. The importation of raisins into France amounts to seventy thousand tons, representing thirty eight million francs: these raisins give about three million hectolitres of wine. The wines of the second vat amount to about the same quantity.

— Victor Giraud writes from Karema in good health. He had spent a month on Lake Bangweolo, where several errors of the charts of Livingstone were corrected, among others the position of the Luapulu River, which really comes out of the south-west part of the lake, instead of the north-west. This part of

rk was undertaken with eight men, the remain-
the caravan waiting for Giraud near Kazembe.
ed by the natives, their boat was finally aban-
near the cataract of Mombottuta. At ten days'
they reached the chief of the Muaumi, who
d them in semi-captivity two months. Finally
g, they crossed Itahua, and reached Tangan-
nd Karema by the 14th of February last. Gi-
tended to remain there about a month, then to
to M'para, and attempt to reach Leopoldville
ersing Marungu and the Lualaba on about the
allel.

shop Levinhac has left Tabora, and is momen-
xpected at Zanzibar. The stations under his
ision were flourishing at last accounts, as were
f the Pères du Saint-Esprit.

Bird nomenclature of the Chippewa Indians' is
ading of an instructive linguistic article in-
by W. W. Cooke in the July number of the
The Ojibwē names of one hundred and twenty-
ds, most of them with their etymologies, are
rated in this paper; and it may be safely said
ly a naturalist can obtain the Indian equiva-
f so many species with so much accuracy as
it done by Cooke. These Indians give names
vinter residents, since at that time bird-life is
ce that each one is accurately noticed; but of
r residents they know with distinctness only
unted for food.

tated by Cooke, nearly one-half of the bird
given by Bishop Baraga in his celebrated
dictionary have wrong definitions. If true,
ll go to show, that, to take down correctly the
equivalents for objects of nature, the collector
be a linguist and a naturalist at the same time;
is by no means certain that the Indian names
ls and other animals do not sometimes shift
one object to another similar one. Ridgway,
Gabb, and others have paid considerable atten-
the gathering of Indian terms of natural his-
nd it is desirable that other naturalists follow
xample, giving the etymology of each name, if
ble.

any local names occurring along the Mosel
e Middle Rhine have, through their quaint and
sounds, proved attractive to historians and lin-
Hubert Marjan, their most recent investiga-
s just published the fourth instalment of his
l researches (Rheinische ortsnamen, 39 p.) on
bject, in which he follows the only true method
lose the origin of names, which is the historic
The early orthographies of names, as found in
authors and in the more ancient mediaeval
nents, necessarily come nearer to the original
than the name-forms we use to-day: hence
bases his conclusions upon the earlier forms,
the majority of instances his results meet our
al. The most ancient topographic names of
arts are Celtic; but the names of Low-Latin
omance origin far exceed the Celtic ones in
r, the German names being late additions.
ehren is derived from *nucaria* (*silva*), 'walnut-grove;' Tholey from *tilietum*, 'linden-grove;' Kärmeten from *carpinetum*, 'horn-beech grove;' Zons from *uncia*, 'agricultural field;' Ülpenich from *Ulpius*, a man's name. In the mountainous tracts of the Hunsrück, Maifeld, and Eifel, our author discovers a considerable sprinkling of Slavic names, but neglects to follow up their etymons through all the eight or ten Slavic dialects known to us. The existence of Slavic names in these western countries is explained by the historic fact, that, after a Gothic war, the emperor Constantinus settled three hundred thousand Sarmatae in various parts of the Roman dominions, a part of which can be historically traced to the Hunsrück and to the plateau of Langres in France (about A.D. 334). Prof. A. Bacmeister had previously (1870) attempted to trace local names of Bavaria and eastern Würtemberg to a Slavic origin.

— We reproduce from *La Nature* a cut illustrating an experiment which shows the pressure of the air most markedly. A thin strip of board is rested on the edge of a table, its inner end being covered by a

sheet of paper, as shown. When arranged in this manner, it will be found that a sharp blow may be given the board, without effect, even if it would fall of its own weight without the paper.

— At a meeting of the Royal astronomical society on June 13, Mr. Ranyard read a paper on the cause of blurred patches in instantaneous photographs of the sun. If the image of a bright star in a reflecting telescope is observed out of focus, ripples of light may be seen passing across the bright disk, which is really an image of the speculum, with the flat projected on its centre. That these ripples are due to the unequal refraction of heated air-currents, Mr. Ranyard showed by placing a hot iron in the tube of the telescope, which increases the distinctness of the ripples, as well as the velocity with which they move across the image. In the image of a uniform bright disk, their effect is to give rise to areas of greater and less brightness, which float across the field as the heated air rises. This was proved by means of instantaneous photographs of the sun, taken with a heated iron in the mouth of the telescope, and when the sun was near to the heated roof of a house.

—An announcement is made in the *English mechanic*, that oil-bearing strata exist in the neighborhood of Sibi, southern Afghanistan; and the government have determined to procure the necessary machinery for boring-operations, which, it is said, will be commenced next winter.

—Mr. C. L. Prince of Crowborough has presented to the Royal astronomical society a great rarity in the shape of a copy of Sherburne's poetical translation of Marcus Manilius, 1675. The volume is valuable for the extensive list of oriental astronomers it contains, and as an English translation of Manilius's Astronomicon poeticon. Mr. Knobel said that for six years he had searched all the booksellers' catalogues without finding it. The library of the Royal observatory, Greenwich, came into possession of a copy by purchase four or five months ago, and it may seem not a little remarkable that two copies of so rare a work should come to light almost at the same time.

—A full list of the papers at the International conference on education, in connection with the International health exhibition, appeared in *Nature* for July 10.

—Number xiii. of the signal-service professional papers, recently issued, contains the results of an extended investigation by Professor William Ferrel on the 'Temperature of the atmosphere and earth's surface.' This is Mr. Ferrel's first memoir completed since his engagement under the chief signal-officer: it is characterized by the same comprehensive mathematical treatment of physical problems that marked the 'Meteorological researches' which he undertook a few years ago for the coast-survey. The broad subject of meteorological temperature is arranged under four headings,—first, the relative distribution of solar radiation on the earth's surface (the mean vertical intensity of solar radiation for one day at the top of the atmosphere is here tabulated for twenty-four epochs in the year, and for every ten degrees of latitude in the northern hemisphere); second, the conditions determining the relations between the intensities of solar radiation and the resulting temperatures, in which the diathermance of the atmosphere is considered; third, the general subject of actinometry, in which two series of experiments give the mean solar constant as 2.255 and 1.991, and from these, compared with others, the value 2.2 is taken as most probable (it is here concluded that stellar heat is insignificant, and that there is no sensible temperature of space; fourth, the distribution of temperature on the earth's surface, and its variations, where, among many conclusions, there may be mentioned the determination of —100° C. as the approximate mean temperature of the earth without an atmosphere; 0.213 as the share of dark heat radiated vertically from the earth's surface, which escapes through the atmosphere into space; and the difference between mean equatorial and polar temperatures on a dry-land earth at considerably more than 115° C., ocean-currents being chiefly responsible for diminution of this extreme condition.

—The English bark Churchstow, Capt. Adams, reports that in a voyage to Columbo, Ceylon, she fell in with large quantities of pumice-stone, Feb. 29, 1884, in latitude 18° south, longitude 73° east. The pumice-stone was partly covered with barnacles.

—It seems that Mr. Cailletet has perfected his method for liquefying oxygen; since this body may be obtained in sufficiently large quantities to appear in the form of a colorless liquid, very volatile, and much resembling liquefied sulphurous acid. The author began by liquefying ethylene by the aid of solid carbonic acid and pressure. By means of this he liquefied formene; and, by the cold produced during the evaporization of the formene, oxygen was finally liquefied.

—*Nature* states that the educational statistics of Japan for the past year show that the number of common schools throughout the country is 29,081, being an increase of 339 as compared with the preceding year; while the number of scholars is 3,004,137, an increase of 396,960; and the number of teachers is 84,765, being an increase of 8,147.

—Miss Amelia Edwards, the honorary secretary of the 'Egypt exploration fund,' has made a communication in the *Academy* about the remains of the statue of Ramses II., found by Mr. Petrie at Tanis. These remains are of red granite. The statue of Ramses II., the contemporary of Moses, was overturned by one of his successors, Sheshank III. By an exact examination and photography of all which was found, Mr. Petrie has come to the conclusion that the statue must have had a height of a hundred and fifteen feet, and thus exceeded all the monuments of that sort hitherto known. The great toe of the statue has a circumference of a foot and a half.

—From a communication of Dr. S. Glasenapp, of the Imperial university at St. Petersburg, to the Russian newspapers, there are in Russia, as we learn from *Nature*, the following private observatories: one at Pervin, near Torjok, in the government of Tver, belonging to Gen. Maievsky; another at Bunakovka, in the government of Kharkoff, belonging to Prince Liven; and one at Odessa, belonging to Mr. Gildesheim. A Polish gentleman, Mr. Wuczihowski, is building a private observatory at Belkave, near Breslau; and a Russian gentleman, W. P. Engelhardt, has a fine observatory at Dresden, equipped with an excellent twelve-inch refractor and a large spectroscope, as well as a selection of the best physical instruments.

—Professor Milne of Japan, says the *Athenaeum*, has established in the Iakashima coal-mine, near Nagasaki, an underground, or, as he prefers to call it, a cetachthonic, observatory. This colliery is worked for some considerable distance under the sea; and it is purposed to establish a regular system of observations on temperature and pressure, and on the tides, earth-tremors, and the escape of gas, carefully noting if any connection exists between them, and establishing a comparison between surface and subterranean phenomena.

—An interesting statistical statement on the use of shorthand-writing has been issued by the U.S.

of education as the second of its series of for 1884, accompanied by a bibliography of ect so far as American and English authors erned, containing about fourteen hundred More than as many German works are known, lications are abundant in other countries. rative view of a hundred and twelve alpha- m 1602 to 1882 is given on a single sheet. of shorthand has largely increased in the States within the past five years. In Wash- the management of some of our scientific , on their present extended scale, would be npossible without it. Certainly the efficiency n service is vastly increased by its use.

April number of *Memorie della Società degli opisti italiani* contains a paper by Dr. J. Hil- ititled "Première étude sur les observations ètre du soleil faites à l'Observatoire de Neu- e 1862 à 1883," in which these observations ussed with reference to a supposed variation pparent angular diameter of the sun, due to ident with the periodicity of the solar spots. dence seems to point toward the coincidence esser diameters with the epoch of maximum ess of the sun's surface.

rain-band spectroscope has a rival in the tion of the stars, as shown by the studies of Montigny (*Bull. acad. roy. Belg.*, April, 1884). s that blue scintillations are more frequent pproach of rain, and considers this the result reater quantity of water in the upper atmos- On the basis of the recent continued diminu- blue scintillations, the author ventures the n for Belgium, that the series of rainy years g with 1876 is now happily ended, and that of drier years is about to begin. The obser- are of value, but the extension of their con- so far into the future does not seem justified.

Tacchini has recently issued two reports of his n connection with rainfall, — Nota sulla osser- pluviometriche eseguite nelle stazioni forestali mbrosa e di Cansiglio; Le febbri malariche teore nella provincia di Roma: Roma, 1884. exhibits the results of rain-measures from 1880 in open fields and under trees. The the latter to the former was from 0.74 to 0.64 r-trees, and 0.76 under beech-trees, and the loss increased in months of less rainfall. tios are, however, open to variation; as they on only a single gauge for the beech-trees, but two for the fir-trees.

elation of malarial fevers to the weather in ince of Rome is a more extended study. A tables gives, first the number of cases of fever arious parts of the province recorded for the arter of each of the twelve years from 1871 then the percentages of fever to population, an average annual ratio of 6.077 per cent, o minima of 2.93 in 1878, and 2.49 in 1882, ching a maximum of 11.42 in 1879. These re next compared with rainfall, cloudiness, ture, and winds; and there is found a clear correspondence between the fall of rain in March, April, and May, and the fevers of July, August, and September; an inverse relation between the cloudiness in June, July, and August, and the fevers of the third quarter; a minimum of fever with a maximum of sirocco winds; and certain indistinct relations of the other elements. All these results are well indicated in diagrams, as well as in tables. They give an increased value to the careful study of rainfall.

— The *Electrical review* states that the Jablochkoff electric candle, the pioneer of all arc-lighting on a practical scale, has ceased, after a period of more than five and a half years, to illuminate the Thames embankment, by reason of the termination of the contract with the Metropolitan board of works. The lights were put up in 1878 for a three-months' trial: consequently the works were not of a permanent character. Yet the lights, with the exception of a few occasional mishaps, have given general satisfaction. No more exposed position could have been selected for such a trial, and the successful working of the system under the circumstances still further proves its value. It is an open secret that the price (one and a half pence per hour per lamp) paid for the lights resulted in a considerable loss to the company. From the recent address of Sir J. Bazalgette at the opening meeting of the Institution of civil engineers this season, it appears that twice the illuminating-power is obtained on the embankment from the Jablochkoff lights as could have been obtained from gas, if the same money were expended: in other words, the price should have been threepence per hour, as compared with the same light from gas.

— According to the *Revue scientifique*, June 21, a distinguished officer of the French army has studied the recently discovered coal-beds in Algeria, and who gives interesting details in the following passage from a letter to the Geographical society of Paris: —

It was at Bou-Saada, that I first heard of the coal reported to be found in Algeria. Coal is found all along the *oued* Bou-Saada, — a large river meandering through a country formed of almost vertical (80°) strata of reddish limestone. These strata lie parallel to the course of the river, so that it seems often to flow between two quite regular walls, whose summits are worn by the winter rains. This formation belongs, I believe, to the lower cretaceous. The traces of coal visible in the strongly eroded croppings which form the bed of the river are very slight (from .001 of a metre to .002 of a metre): they seem inseparable from the grayish-blue, sandy strata, which, at least in the exposed portions, are very small. This sandstone is hard and compact, often spangled with bright grains, which are, without doubt, iron pyrites. These are the first indications of the beds in question.

Mr. Pinard, who devoted himself to an examination of this bed, had shafts sunk at the places where he had determined the presence of croppings. There are three of these shafts, — two very near each other, 3.5 kilometres from the oasis toward the south, on the left bank of the *oued*; and the third is a half-kilometre

farther. At my visit all were filled with water, so that I could study only what had been removed from them. The excavations consisted of sandstone like that mentioned, and of large pieces of marne, black sandstone, foliated, and enclosing thin strata of coal, which in some places measured .01 of a metre in thickness. Rumors of the officers stationed at Bou-Saada state that pieces of rather hard coal have been taken from the shafts, and that the stratum encountered was at times almost a metre thick. This coal, on breaking, is bright, compact, and of a good appearance, burns well, with a beautiful flame, and gives a light, brilliant coke.

— The Prussian minister of instruction has published an opinion on the overwork in schools through the medical deputation sent to him on the subject. The evil exists not only in the upper and middle classes of the high schools, but in the earlier school years. It is strongly recommended that pupils should not be received into the elementary schools until the completion of their seventh year, and not into the gymnasial sexta until their tenth year.

— The new German orthography, supposed to be more phonetic than the old, is to be made official next year in the Grand Duchy of Oldenburg.

— Two important geographical works are projected at St. Petersburg. One is, according to Professor Veniukoff, the preparation of a grand monograph on the physical geography of European Russia. Several members of the imperial geographical society have been constituted a committee to elaborate the project.

The second is the preparation of a good general map of the same region, for the use of the public, to replace that issued by the society in 1863. The selection of matters to be omitted or retained is to be made by specialists, and approved by an editorial commission. The execution will be in the highest style of cartography.

The report on the unification of Russian geodetic and topographic work has been elaborated by the commission, and submitted to the general government for approval.

— Revoil has returned to Zanzibar from his explorations among the Somalis. Although prevented by a state of things resulting from the disturbances in the Sudan from carrying out his original plans, he made good use of his forced sojourn at Guelidi and on the Benadir coast. He devoted his attention to the archeology and natural history of this region, and has brought back valuable collections and notes on the resources and productions of the country.

— Ussagara mission station has been visited by famine due to drought. The Rev. Bloyet writes, that, notwithstanding this, the people about the station are well disposed.

— The work upon the canal between the gulfs of Corinth and Aegina is being energetically pushed, and another year will probably see it completed. Advantage will be taken of the vestiges of the canal begun by Nero. The trench will be a straight line, about six kilometres in length, including the basins at either end, and crossed by two bridges. The greatest height of the ridge to be pierced is about seventy metres. The completion of the canal will shorten the distance between the Adriatic ports and those of western Turkey, — Salonica, Constantinople, Smyrna, etc., nearly two hundred miles, and for vessels from the Atlantic about half as much, beside enabling them to escape much dangerous navigation. The tariff will be fixed at one franc per ton for vessels from the Adriatic, and half a franc for others. The monthly movement of tonnage is at present about 137,000 tons, mostly in small vessels, the local trade being extremely large. The contract for cutting the canal has been taken for about five million dollars, and there is no reason to suppose that this will be exceeded.

— The important question of a port of embarkation in south-eastern Brazil for the region about the lagoon or estuary known as Lagoa dos Patos has recently been discussed by the engineers Plazolles and Sichel. On the borders of the lagoon are the important colonies of Porto Allegre, Rio Grande, and Pelotas. By steamers of light draught communication is had with an extensive interior region containing a large population. The entrance to the lagoon, however, is composed of a shallow passage obstructed by shifting sands, where the bad weather of a day may obliterate the effect of dredgings during several months. The peninsula, which extends between the lagoon and the Atlantic, has been supposed to be of a sandy or porous nature, unsuitable for permanent works. Recent investigations by the above-mentioned gentlemen show, however, that this idea is erroneous, and that the foundation of the peninsula is a compact, hard clay, well suited for excavation. These engineers propose to select a favorable spot, where a large fresh-water lake exists, to dig out a small basin at the coast capable of containing several large vessels, and to connect it, by a canal deep enough to admit the largest ships, with the above-mentioned lake, which is to be dredged out to form an extensive basin or port. As the Lagoa dos Patos is too shallow to accommodate large ships, the freight is to be transferred, by a railway eighteen kilometres long, to the point where the light-draught vessels of the lagoon can be reached. The projectors ask only an authorization to make and maintain the works without subsidy or guaranty. The *Brazilian messenger* states that it is now practically certain that this important work will be carried out, thereby giving the colonists excellent facilities for commerce, the want of which has hitherto crippled the development of a rich and healthy region.

— The government of the Argentine Confederation, in the hope of obtaining water by artesian borings, has ordered an investigation of the geology of the San Luis district. Water is generally found only at a depth of one hundred and eighty feet. Potable water is usually reached at that depth; but at Upper Pencoso only salt water was found, though at a height of fifteen hundred feet above the sea, while at Cuijades the water is hot, reaching 75° F.

SCIENCE.

FRIDAY, SEPTEMBER 19, 1884.

COMMENT AND CRITICISM.

The Philadelphia meeting of the American association is credited with being the most successful up to this time. The total attendance was 1,249. Great Britain contributed 303; Pennsylvania, 246; New York, 161; Massachusetts, 87; District of Columbia, 84; New Jersey, 58; Ohio, 57; Connecticut, 32; and Virginia, 22. The membership was increased nearly twenty-five per cent, 515 new members being elected, and the number of members up to this meeting being 2,033. The number of papers read was larger than ever before; and it is to be hoped that the weeding-out of the trivial matters so often offered was carried to a greater extent than usual. There was a general feeling that there was too much going on. A large portion of the physicists were engaged as examiners at the electrical exhibition, and were, of course, interested in the meetings of the electrical conference. Somewhat less science, and somewhat more time to enjoy the junketing, would be more in accordance with the desires of many, if one may judge from the opinions expressed on the way home. A proposition to confine the reading of papers to the mornings would have met with many supporters.

The International association, which has been so earnestly advocated by Dr. C. S. Minot, has now a more assured existence; thanks to the fund of twenty thousand dollars, which will be established through the liberality of Mrs. Elizabeth Thompson. Of this fund, five thousand dollars have already been paid to the association; and five thousand more will be paid next year on condition of ten thousand being raised from other sources. The income from this fund is to be devoted to research. Not only did Mrs. Thompson give liberally to this new society, but also gave one thousand dollars to the American association for the advancement of science, to be used in researches on light and heat. Mrs. Thompson takes great interest in the recent marvellous advances in the application of electricity and felt a desire to contribute, as far as lay in her power, to the advancement of our knowledge of the forces of nature. Appreciating the unity of energy, whether displayed as heat or light or electricity, Mrs. Thompson gave the money for researches as to the nature and sources of light and heat, in the hope that more may be learned of the connection which may exist between heat and light and electricity.

Congress passes laws to favor science and literature in importations; and the treasury officials, under the pretence of protecting the revenue, interpose vexatious requirements, which defeat the purpose of congress. Are the treasury officials so devoid of administrative skill that they cannot devise some way to further the end of congress, and protect the revenue at the same time? Have colleges, for instance, no rights under the laws which treasury officials are bound to respect? What is the use of congress giving colleges the right to import current periodicals, duty-free, if these protectors of the revenue cause delays and expense, to incur which were worse for the colleges than to pay duty? Under recent decisions of the treasury, each successive part of a periodical for a public institution must be made the matter of a distinct oath, involving time and money, and the passage and re-passage of documents between the college and its agent at the port of entry. If all the wits these treasury officials have spent in devising these vexations are not exhausted by the process, they may perhaps calculate what new endowments colleges will now need to help these officials protect the revenue! It is hard to contemn the witless.

AMONG the meetings which have just been held in Philadelphia, was a friendly and informal gathering of some of the contributors to *Science*. About thirty persons came together, and listened to some statements which were made on the part of the managers, and expressed their views in respect to the position which this journal has taken and may take. The tone of the meeting was in all respects encouraging. A review which had been made of the subscription-list, by our publisher, shows that these pages now reach the chief scientific institutions and the chief scientific workers of the country. An effort will next be made to secure an extension of the circulation among other intelligent and educated classes.

Our contributors were invited at this meeting, and are always invited, to bear in mind that not only *Science* as a journal, but science in higher and broader aspects, will be best promoted by enlisting the attention of the general reader to the results which are attained in all departments of knowledge. This can only be done if our friends will write as persons who are specially informed, to persons who are not specially informed, on the subjects treated in our columns. One of our most valued contributors says that the man who is eminent in one department may have only an ordinary knowledge of other subjects: the greatest astronomer may be a tyro in entomology; the best of chemists may have no conception of elliptic functions. *Science* in its articles should be readable throughout; and, if our friends will continue to help us, we shall soon reach success.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Phosphorescence in the deep sea.

The following paragraph by Dr. Studer,[1] the naturalist of the Gazelle, has probably escaped the notice of those who have lately written regarding the protective nature of the phosphorescence of pelagic animals. He closes a general description of phosphorescence in marine animals, and the probable nature of it, as follows: 'Immer aber ist es ein von aussen kommender reiz, welcher das leuchten hervorbringt, so dass wir vielleicht die erscheinung als eine schutzvorrichtung für das tier betrachten dürfen.' He further says, on the same page, 'Wir dürfen vielleicht annehmen, dass es vorwiegend rote und orange strahlen sind, welche in diese tiefen gelangen (2–300 faden), dass die blauen und violetten schon vorher absorbiert und reflektirt werden. Daraus würde sich dann die vorwiegend rote färbung der Crustaceen als eine schutzfärbung erklären lassen, wie die vorwiegend blaue der am tage erscheinenden geschöpfe.'

ALEXANDER AGASSIZ.

Newport, Sept. 12, 1884.

[1] Ueber einige wissenschaftliche ergebnisse der gazellen-expedition. . . . Verhandlungen des zweiten deutschen geographentages. Berlin, 1882.

Fish remains in North-American Silurian rocks.

The Rev. W. S. Symonds seems somewhat disturbed by my letter of July 11. He apparently fears lest the honor of yielding the earliest fish-remains should pass from England to North America.

My note to *Science* was purposely made very short, but I was quite aware of the fact that a *single* specimen of Scaphaspis Ludensis (not fish-remains) had been found in the *lower* Ludlow rocks. Mr. Symonds will excuse my reminding him that Sir C. Lyell mentions this discovery by Mr. Lee at Leentwardine in 1859. The statement may be found in his Elements for 1865: not having the book at hand, I cannot name the page. Professor Lankester also, in 1869, refers this species to the *lower* Ludlow. To have been unacquainted with the fact would therefore be inexcusable.

Mr. Symonds will probably be surprised to learn that I am a native of the county (Herefordshire) in which he has himself done so much excellent geological and archeological work. I have been familiar from boyhood with much of the country which forms the 'hunting-grounds' of the Woolhope club, and visited some of them as lately as 1879.

As an abstract of my paper will shortly appear, I refrain from giving details at present.

E. W. CLAYPOLE.

B. A. A. S., Montreal, Aug. 29.

Korean curios.

The article in *Science*, No. 82, entitled 'Korean curios,' contains some errors, excusable, however, when one considers the difficulty of speaking through two languages, and getting the information filtered back through the same channel. For these corrections, and the brief information embodied in them, I am indebted to one of the Korean embassy, Mr. Yu, who has been with me constantly for several months, and who now speaks very good English.

The ring worn upon the thumb of Min Yong Ik (who, by the way, is not a prince, but a noble) is the Chinese thumb-ring worn in archery, by means of which the bowstring is drawn back. These rings are often very expensive. I was shown one in Canton valued at one hundred and fifty dollars, and some are valued much higher. The Korean archery-ring for the thumb is nearly always of horn, and entirely different in shape.

The amber bead is not necessarily imported; as amber is found in Korea, and is recognized by the Koreans as being a kind of gum from pine. They regard the best and oldest, which is of light color, as being three thousand years old; the darkest and poorest as being one thousand years old.

The button represented in Fig. 4 can only be worn by high officials. Officers of the first rank wear

quartz ones, while officers of the second and third rank wear gold ones. These buttons are secured to the customary band made of hair and not of velvet.

The reason given for leaving the wife at home — namely, that her clothes would not have stood the wear of the journey — was a polite excuse only. Social custom would have rendered it impossible for any of them to bring their wives with them.

In regard to the extraordinary crystals, my informant's brother has seen the region where they occur, and says the wonders of it are beyond description. He describes it as bordering the shore for a distance, in one measurement, of fifteen miles.

Mr. Kunz is quite right in regarding them as crystals of quartz; for Mr. Yu says they are white, and also like glass, and assume branching forms like trees, columns, etc., and tower at greater heights even than the dimensions given by Mr. Kunz. This region is on the eastern coast of Korea, and has never been visited by foreigners. The Chinese have in vain tried to get permission to visit this place.

EDWARD S. MORSE.

A COMPARATIVE STUDY OF THE ASSOCIATIONS.

To us on this side of the Atlantic, the opportunity to profit by the contrast of the two association meetings just closed ought not to be lost; and the desire to take advantage of it may justify a somewhat extended comparison of the two associations.

Concerning what may be called the 'physical features' of the two meetings, their relation to each other may be readily seen by an inspection of the following statistics: At the Montreal meeting, the total registered attendance was 1,773, of which nearly half crossed the ocean, and about six hundred were classed as 'old' members. The total number registered was somewhat below the average of the past ten years, which was 1,889, not including last year's meeting. The largest meeting ever held by the British association was at Manchester, in 1861, when the registry was 3,944; the smallest, in recent years, at Swansea, in 1880, the number being 899. The number of registered members at Philadelphia was 1,261, the greatest number ever on the rolls of the American association at one meeting. It is not unlikely that the excess of more than five hundred in the membership of the British association over that of the American is to be partially attributed to the rule of the British association, which confines the privileges of attendance to members of one class or another; while the policy of the American association has been to invite and to welcome all who are interested in the proceedings, regardless of membership.

At the Montreal meeting, the total number of papers read was 327. At Philadelphia, 304 papers were read. The number of papers on mathematical and physical science was ten greater in the American than in the British association. In the latter, however, the number of physical papers was greatly in excess, as those concerning pure mathematics were disposed of by a sub-section in a single day.

In addition to the regular papers, there were, in the various sections of the British association, more than fifty reports presented, coming from committees appointed at previous meetings for the consideration of special subjects. Of similar reports in the American association, it can hardly be said that there were any, such as were offered being mostly confined to a few words declaring 'progress,' asking for continuation, and promising something in the future; and even this much was only obtained after much labor on the part of the presiding officer.

As to the general character of the meetings, it may be said that both were above the average. Sir William Thomson declared, at the closing session of the British association, that it was one of the most satisfactory ever held; and both he and Lord Rayleigh declared that the meetings of section A were far above the average.

It can be affirmed without boasting, that Americans (citizens of the United States) contributed in no small degree to insure this success. At least forty, or about one-eighth, of the entire number of papers read, came from them. They joined in several of the important discussions, and generally with credit; and some of them — Newcomb, Rowland, and possibly others — presided over sections at various times. It is well worthy of note, that, of the five papers recommended to be published *in extenso*, one was from Professor Gray, and another from Professor Thurston.

The Philadelphia meeting of the American

association was doubtless, all things considered, the most successful yet held. The work done in sections was, in general, of a higher order than usual; and we are, in turn, indebted to the visiting members of the British association for valuable assistance in 'bringing up the average.' Many of them presented papers, and took part in the discussions which now and then arose in various sections.

The greatly inferior quantity, if not quality, of the work done by our special committees, is unquestionably due, to a great extent, to a fact already referred to in these pages. The committees of the British association are aided by grants of money, as much as $7,500 being allowed at the Montreal meeting. Could the committees of our association obtain such grants, their work would undoubtedly be vastly more satisfactory. Besides, being thus relieved from the purely mechanical drudgery of the work, the feeling of responsibility would be much greater, and each committee would recognize the necessity of justifying its existence, and of showing that the money given as aid had been well invested.

On the whole, it will be admitted that the British association does its work upon a higher plane than that occupied by the American. Its sectional work shows more that is really new and of lasting value, and less that is trifling; although there has been a steady and healthful improvement in the character of the American association during several years past. It may be well to remark here, that there are at least a few of the ablest and best men in American science who have continued to exhibit no interest in the American association; and that, if the association is not precisely what they believe it ought to be, the fault lies at their own doors. No others should or could be so influential in shaping its course and moulding its character.

It may be well, however, to turn from the consideration of these graver differences between the two associations, and notice briefly some of those distinctions which are more personal in their nature, between the members themselves.

Our English cousins certainly possess an enviable capacity for recognizing the amusing side of affairs. At Montreal one came to expect pleasant little outputs of the mildest humor in the midst of the profoundest scientific dissertations. Your formula might be torn to shreds by severe criticism, but your fun was welcomed without examination.

In the matter of paying compliments, and moving thanks in an easy and graceful manner, our English cousins have the advantage of us. It is the almost universal custom for the chairman of the section to thank the reader of a paper, and often in elaborate terms. This consumes a good deal of time, and it is a question whether such wholesale compliment is desirable. It was observed, however, that the distinguished and genial presiding officer of one of the sections made use of two quite different formulae for expressing his appreciation of the merits of the paper: in one case hoping "that the section would join him in thanking Professor —— for his interesting and important communication upon this subject;" and in another, "that the section would join him in thanking Professor —— for his communication upon this interesting and important subject." The importance of the proper arrangement of words was never shown to better advantage.

The undemonstrative character of the American as compared with the Englishman was exhibited in the public meetings of the two associations. The American association has seldom had so felicitous an address from a retiring president as that of Professor Young, and the probability that it was not generally heard throughout the vast academy of music was the only excuse for the fact that its many good points failed of that recognition which they so richly deserved. This failure was commented upon by an Englishman in a remark to the writer, that such an address would have been much more frequently applauded in England. "We constantly interrupt a speaker to applaud him," he said, "if for no other reason than to afford him a breathing-spell."

THE CARSON-CITY ICHNOLITES.

THE fossil footprints upon the layers of sandstone in the quarry at Carson City, in the state of Nevada, have excited much interest and discussion, not only by reason of the number and grouping of animals represented, but especially because some of the tracks have a rough resemblance to such footprints as a man of great size might make in walking upon soft mud. Elaborate reports and memoirs have already appeared,[1] regarding these tracks; and in California and Nevada there has been, and continues to be, a great difference of opinion as to the origin of the tracks which resemble the imprints of human feet. These tracks occur in a light, gray-colored, coarse sandstone formation, of the mammalian age of the tertiary, lying in nearly horizontal beds, with thin partings or layers of clay at intervals. The section at one point directly above one of the series of tracks is as follows: —

Sandy clay	18	inches.
Sandstone	4	feet.
Clay	$\frac{1}{2}$	inch.
Sandstone	16	feet.
Fine clay	2 feet 2	inches.
Coarse sandstone	10	"
Sandy clay, with tracks . . .	3	"
Sandstone	18 to 24	"
Clay layer, with tracks .	1 to 2	"
Sandstone below the quarry floor,	38	feet.

The tracks represent at least ten different animals, as follows: Elephas, or the mammoth; elk, or American reindeer; Bos, or buffalo; horse; wolf; tiger; peccary; Mylodon, or a giant sloth; the so-called 'Homo Nevadensis;' birds.

Bones and teeth of the elephant and of the horse have also been found in the sandstone beds above the ichnolites. There are also casts of shells of Anodonta, and an abundance of casts of reeds and aquatic plants, directly overlying the layers of silt or mud on which the tracks are found.

The sequence of events is plainly recorded in these beds. The floor of the quarry marks the close of a period of strong currents of water, depositing sand. A period of quiescence ensued, with the deposition of a fine clay or silt. This was drained of water, and became firm enough for animals to walk upon it and leave their tracks. This layer is separated from a second clayey layer by about eighteen inches of sand, marking an overflow and a second period of quiescence and drying-up. The tracks are most numerous and distinct upon this second layer. Immediately over it we find several inches in thickness of fine clayey sediment, penetrated by aquatic plants, with the remains of fresh-water shells, indicating the existence of a shallow lake or lagoon for a considerable period. The overlying coarse sandstones show the influx of strong currents, bearing the sand and the bones of animals from some point beyond, and higher than the tracks.

It is probable that these deposits were formed near the mouth of a comparatively large stream, subject to floods, and flowing into a shallow lake. Such conditions are not unlike those we now find all along the eastern base of the Sierra Nevada, where mountain torrents pour out into elevated valleys without outlet, and form broad lakes, which vary greatly in their extent at different seasons of the year. During the season of the melting of the snows, the lakes cover a much greater area than in the dry season, when the rivers cease to flow, and the lake-water disappears by evaporation. Large areas of the shores of such lakes then become exposed, and are gradually dried. If, as in the case of the deposits under consideration, the upper clayey sediments are underlaid by coarse sandstone, the clay layer is rapidly dried by under-draining, and affords a firm footing for animals in search of water. This need of water may account for the number of animals which crowded together at this place. It is possible, also, that a warm spring existed there, as at the present time, drawing animals toward it from the surrounding deserts.

The sandstone surface is distinctly marked by raindrop pits and by ripple or wave marks.

Tracks of the mammoth or elephant.

These appear as a series of circular depressions from three to six inches in depth, and averaging twenty inches in diameter. The most important series is forty feet long, and has ten distinct footprints. Most of these have a raised margin or border of clay in ridges, due to the great pressure and squeezing of the clay.

[1] Footprints found at the Carson state prison. By H. W. HARKNESS, M.D. *Proc. Cal. acad. sc.*, Aug. 7, 1882.

On certain remarkable tracks found in the rocks of Carson quarry. By JOSEPH LECONTE. *Proc. Cal. acad. sc.*, Aug. 27, 1882.

Prehistoric footprints in the sandstone quarry of the Nevada state prison. Description by CHARLES DRAYTON GIBBES, C.E., Sept. 4, 1882, to accompany diagrams of footprints.

HARKNESS, *Proc. Cal. acad. sc.*, August, 1883. (Abstract in *New-York evening post.*)

O. C. MARSH, *Amer. journ. sc.*, No. 152 [3] xxvi., August, 1883.

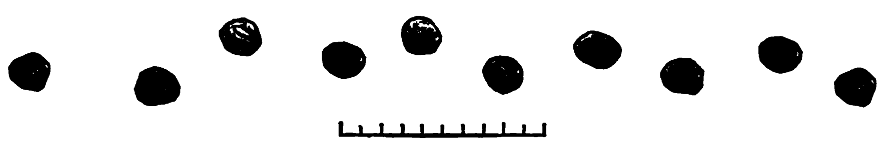
The Carson footprints. Report of Professor GEORGE DAVIDSON, president of the California academy of sciences, August, 1883.

Ichnolites of the Carson quarry. W. P. BLAKE. *Trans. Conn. acad. arts and sciences*, February, 1884.

The stride of the elephant which made the tracks here represented was about five feet eight inches, and the straddle three feet five inches, measuring from outside to outside.

Tracks of man (*so called*), **or mylodon** (?)

The long and curved tracks, which have excited the greatest degree of interest from their supposed human origin, extend in several different directions, but generally in straight direct lines. The longest series has forty-four tracks, and is a hundred and twelve feet long.



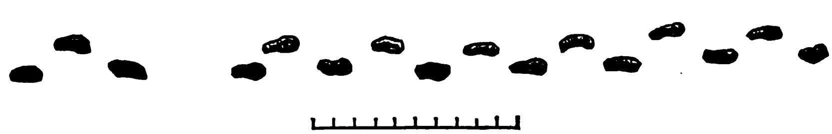
10 feet.

FIG. 1.—TRACKS OF THE ELEPHANT.

Another set of tracks is the most distinct of all, and is upon the upper layer of silt or clay, two feet above the general level of the quarry floor. A rubbing upon paper twenty-seven feet long, covers twelve tracks of this series, and shows the general form and the exact sequence and position of these tracks. The imprint on the paper being formed by rubbing with a graphite pad, it gives a more accurate idea of the shape of the tracks than any drawing made with hard, sharp outlines; for none of the outlines are sharply marked, but the depression gradually shades off into the generally plane surface. For this reason it is not easy to state definitely the exact size of these tracks. They may be said to be generally from nineteen to twenty-one inches [illegible], and from six to nine inches in [illegible] The form is curved, not greatly un-[illegible]er curve of the human foot. The [illegible] depression is irregular and trough-[illegible] at the centre, as if the greatest [illegible] exerted there; in this respect dif-[illegible]lly from the impress of a human [illegible] without the heel and toe depressions, although some of the tracks show a more abrupt depression at the supposed heel than at the other end.

In order to explain the great size of the tracks on the theory of their human origin, and, further, to explain a peculiarity in the form of some of them, it has been asserted that sandals were worn. This peculiarity consists in a flat, tabular surface or border, extending, like a terrace, from an inch to two or three inches wide along the inner margin of the track. This is thought by some to be the impress of the sandal. The tracks having this peculiarity are shown of full size in figs. 1 to 5, attached to the memoir of Dr. Harkness. While he is fully confident that these are the imprints of sandals, he points out a very significant fact,—"that the impression is upon the same plane in each of the diagrams, and that there is no indication of toe or pad or arch in any of them" (p. 7).

A critical examination of these tracks having the partial border of a flat surface, showed that this flat margin marks a parting or dividing plane in the sediments along which the clay-like layers separated; such portions, apparently, as were not crushed and broken through, being lifted off as the foot of the animal was raised and carried forward.



10 feet.

FIG. 2.—TRACKS RESEMBLING THE IMPRINT OF HUMAN FEET.
(*From the plan by Gibbes.*)

The fact that it occurs irregularly, sometimes on one side of the track for a short distance, and sometimes on the other, and irregularly at the end, and is sometimes entirely absent, goes to show that it was not produced by a flat, rigid surface. Besides, we cannot conceive of a flat sandal, such as would be required to make a *flat* imprint, permitting the central part of the track to be so greatly depressed. And in walking with sandals, the toe in leaving the

k, especially in a soft, muddy surface, tends epress, and throw back the mud towards centre of the track, whereas the conditions iese tracks are reversed. A longitudinal ical section of one of these tracks would be ly as in the diagram, the greatest depres- being in the middle.

FIG. 3.—CROSS-SECTION OF IMPRESSION.

he breadth of the track-way, or straddle, is next great objection to the theory of human in. The whole breadth is from twenty- t to thirty inches, whereas man requires, alking, not over ten or twelve inches. If ake the ordinary stride of a man six feet at twenty to twenty-four inches, the ratio he breadth of space required in walking his step is as ten or twelve to twenty wenty-four, or 1 : 2; while in the tracks re us the ratio is as twenty-eight to twenty- n, the step, in fact, being less than the ddle. This alone is fatal to the bipedal ry, and in favor of the quadrupedal; for the quadrupedal theory the length of step ty-six to sixty-two inches, and, the width g twenty-eight to thirty, the ratio of the h to the length is nearly as one to two.

here are also evidences of a duplication of ks made by the hind-feet overstepping the ints of the fore-feet. This has been par- arly pointed out by Professor Davidson in eport.

he tracks of this series all have the appear- of being made by an animal with short for it is evident that there was a slid- n and out of the foot, particularly in the gh-shaped impressions of the lower horizon ay.

hen first opened, these are always filled up a compressed mass of clay and sand; and etimes traces of a coarse, sedgy grass or tation are found, as if it had been pressed n under the foot into the clay.

he opinion of Professor Marsh, that these ks were formed by one of the edentates, is in accord with the phenomena, and appears nore reasonable when we give due weight e fact that some of these animals are be- d to have walked partly upon the side of oot and leg, thus carrying their great claws ch a way that they left no imprint.

Elk (?)

the supposed elk-tracks there are thirteen quence, each track from four to five inches long by three and one-half wide, average step eighty inches, and breadth of track thirteen inches.

Deer.

The series referred to the deer is twelve feet one inch in length, and includes ten tracks of an animal with a sharp-pointed hoof, triangular in form, measuring two inches by two and one-half inches.

Birds.

The bird-tracks are numerous, and are generally about six inches in length and breadth, showing four toes, as in the figure.

It is well to note that the intense interest attaching to the question of the human origin of some of the tracks has greatly overshadowed the importance, geologically, of the whole series and the lessons to be learned from them. There has not been such an important discovery of fossil tracks since the unearthing of the fossil footprints in the sandstones of the Connecticut valley. These last were discovered in 1800, and served to stimulate and to foreshadow our knowledge of the forms of life between birds and lizards. The venerable Dr. Hitchcock, the author of 'Ichnology of New England,' in contemplating the evidences of the

FIG. 4.—BIRD-TRACK.

so-called bird-tracks of the Connecticut valley, was led to exclaim, "Indeed, some of the tracks of these narrow-toed bipeds have such a resemblance to the feet of some lizard, that I anticipate the discovery of front teeth."

He cites Owen as saying, before fossil footprints were known, that "a single foot-mark of

a cloven hoof indicates to the observer the forms of the teeth, of all the big bones, thighs, shoulders, and of the trunk of the body, of the animal which left the mark."[1]

W. P. BLAKE.

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THE VIRULENCE OF CULTIVATED ANTHRAX VIRUS.

Experimental studies on the artificial attenuation of the infectious properties of the bacillus of Anthrax by means of cultivation. By Dr. R. KOCH, Dr. GAFFKY, and Dr. LOEFFLER.

Mittheilungen aus dem Kaiserlichen gesundheits-amte. Zweiter band. Berlin, 1884. (Extract from the publication of the imperial board of health of Germany.)

PASTEUR's announcement that the parasites of malignant Anthrax were capable of changing their characteristics when cultivated under certain conditions, and that when thus modified they could be used for protective inoculation, aroused the greatest interest among investigators. Such a statement could not be accepted without confirmation at the hands of other observers; and none were better fitted for this task than the Royal health commission of Germany, at the head of which stands Dr. Robert Koch.

The experiments, which were instituted under his direction, have been carried on for two years, and have shown, that, although the bacilli could be rendered harmless, their protective power was not so great as was expected.

The original communication of the French *savant* was not exact in the details by which the experiments were to be carried out, and Koch had to employ much time in preliminary studies. This cannot, however, be considered as lost, since many valuable facts have been obtained by it.

According to Pasteur, if the cultivations were kept at a temperature constantly maintained between 42° and 43° C., the virulence gradually decreased until the ninth day, when it was entirely lost. By removing a specimen on any day, and allowing it to germinate at a temperature of 37° C., its activity at that stage could be perpetuated, and thus any degree of virulence that was required could be preserved. Two such cultures of different strength were used for protective inoculation, the weaker of which was called the *premier*, and the stronger the *deuxième vaccin*.

Koch commenced his investigations in the following way. A mouse was injected with blood containing spores of the bacillus, which had been kept five years, and was known to be of great virulence.

The animal was killed at the end of twenty-four hours, and a minute quantity of the spleen was taken on the point of a platinum needle which had been sterilized by heat, and sown in a glass bulb containing twenty cubic centimetres of chicken-bouillon neutralized with sodic carbonate. The bulb was then sealed, and placed at once in a constant-temperature apparatus, which was kept between 42° and 43° C.

Samples were taken daily, and tested upon animals; but, contrary to the promised result, the growth was found to be as deadly for small animals on the ninth as on the first day. Further cultivation proved, however, that, in a period varying from eighteen to twenty-nine days, the infectious property was entirely lost, although the external appearance of the bacillus was unaltered. Thus far, Pasteur's assertion was substantiated, except in regard to the length of time. A portion of this was taken, and allowed to grow at an ordinary temperature for two years; and during this time there has been no evidence of a return of virulence, nor has the form changed. These bacilli are as immovable as the active ones; their ends appear sharply truncated; they form long filaments, in which are developed oval glancing spores. Vaccination with this entirely inactive form did not give immunity against inoculation with the virulent one.

Those of a slight degree of force were next tried. At the end of twenty-four days a culture was obtained which would kill mice, but not guinea-pigs or other small animals, but still did not render them safe. This particular form Koch speaks of as 'mouse anthrax.'

It was thought that perhaps this represented the second and the inactive form, the first vaccination of Pasteur. Accordingly, a sheep was tried, but it succumbed to the malignant form as quickly as ever. It was next proposed to use three or more preventive inoculations; and, accordingly, cultures from the fifteenth day were taken as the first, from the eleventh as the second, from the ninth as the third, and from the fifth as the fourth, and these were followed by the virulent form. In this manner seven sheep, seven rabbits, and eleven guinea-pigs were tried. At the end, all the rabbits and guinea-pigs, and five of the sheep, had died.

In order to determine whether there might not be some other difference, specimens of the vaccinating-material, as furnished by Pasteur through his agent, were purchased, and proved

[1] *Proc. am. assoc. ad. sc.*, xiv. 146.

in regard to their power. The first corresponded to the 'mouse anthrax' (that is, a culture from the eighteenth to the twenty-fourth day), while the second vaccination corresponded to the ninth day. Six sheep were inoculated with these; and out of these, one died after inoculation with the malignant form. As a result, it can be stated, that, after the most careful protective vaccination, an unconditional immunity against infective inoculation is not reached in all cases. Koch thinks that Pasteur's perfect success must be due to the fact that the malignant anthrax used by him was not so virulent as he himself employed.

The cause of the diminution of virulence is regarded by Pasteur as due to the action of oxygen; by Koch, on the other hand, as due to the effects of temperature alone, even so small an amount as a few tenths of a degree C. causing a marked variation in the length of time required to render the bacillus perfectly harmless. Chauveau's experiments also point in the same direction; for while it took from three to four weeks, at a temperature of 42.5° C., to reach the desired result, it could be attained in a few days at 43° C., and in a few hours at 47° C., while a few minutes sufficed if a temperature of from 50° to 53° was used. The lower, however, the temperature, the more surely is the attenuation preserved in later cultivations. When developed in the bodies of animals for several successive generations, Koch found that there was an occasional tendency, on the one hand, for a weaker form to become more powerful; and, on the other, for a stronger to become weaker. But, as a rule, the degree was preserved unaltered, as in artificial cultures.

The scientific fact that sheep could be rendered safe against inoculated anthrax was confirmed by these experiments. The question then arises, How do the vaccinated animals conduct themselves against natural infection? As is well known, different kinds of animals differ in this respect. Cattle, for example, are very refractory to artificial inoculation, while they are very often attacked from a natural source. Pasteur regards the natural source of infection as much less liable to produce the disease than the artificial. His method of placing a number of vaccinated animals in a meadow, in which notorious cases had occurred, is capable of such great errors that it cannot be relied upon for scientific accuracy.

What is the most common way in which natural infection occurs? One method analogous to inoculation is from the bites and stings of insects, who leave, at the same time, spores of the bacillus, which may be attached to their bodies. Another is by the inoculation of scratches in the mouth, caused by sharp particles of fodder.

Koch believes, however, that the intestine itself is the common place of entrance for the parasite, but only when in the condition of spores.

To show this, a portion of the spleen of an animal who had died from anthrax was put inside a small ball of potato, and placed on the back part of the tongue of a sheep. In this way any danger of wounding the mucous membrane of the mouth was avoided. (Since spores are never formed within the body, by taking a portion of the organs, as above, it was known that it was the bacilli alone that were introduced.) Every experiment failed, even after enormous doses, and thus proved that the bacilli are destroyed in the stomach, and are therefore not in a condition to produce intestinal anthrax. When, however, the bacilli were allowed to produce spores, and these were given, every animal died. The examination after death showed that the spores had developed in the intestinal tract, and the bacilli had invaded the body from these. It is therefore in the highest degree probable that the introduction of spores with the food is the most common source of natural infection. The amount would never be so great at one time as was here used; but, if smaller doses were repeatedly given, the picture of an ordinary epidemic could be nearly reproduced.

Cattle could not be obtained for experiment; but an examination made on a cow who had died from natural infection showed similar lesions in the intestines to those found in the sheep.

Animals with a single stomach could not be infected in this way.

Finally the effects of protective inoculation were tried. Ten sheep were taken: five of these were vaccinated with material obtained from Pasteur, of two different strengths; and five, according to Koch, with cultures of the fifteenth, eleventh, ninth, and fifth day. They were then fed with spores. As a result, two of the first series died, but none of the second.

From these few yet unimpeachable experiments, Koch concludes, that, for a certain number of animals, absolute immunity can be obtained; but he doubts whether a simple vaccination, with only two different degrees of attenuation of the virus, is sufficient to give perfect protection.

EISSLER'S MODERN HIGH EXPLOSIVES.

The modern high explosives, nitroglycerine and dynamite: their manufacture, their use, and their application to mining and military engineering. By MANUEL EISSLER. New York, *Wiley*, 1884. 11+395 p., illustr. 8°.

IN this work the author has sought to acquaint the engineer, the contractor, and the chemist with the composition and characteristics of the high explosives, and with their adaptation to certain purposes. He has been led to do this from "the lack of authentic information on the subject, and the great increase in the use of these explosives;" yet we find the book to be largely a compilation from such well-known works as those of Abbot, Drinker, Mowbray, and Berthelot, together with others not so well known, and from various chemical books.

Such a compilation, if properly selected, digested, and arranged, would be highly creditable, and, in the present state of the art, very useful; but unfortunately, while the fundamental plan of Eissler's book is most excellent, it is badly carried out in detail, since subjects most closely connected are treated of in widely separated places, with a consequent loss of distinctness and consecutiveness, and the introduction of an annoying repetition and sometimes of conflicting statements. Besides, from his custom of copying many of his authorities *verbatim et literatim*, he has introduced examples of most of the many systems of nomenclature known to chemistry. Add to this an obscure style, and the use of words and phrases such as 'chlor-metals,' 'protoxide of azote,' 'resting acids,' 'parchemined paper,' and the like, and we have a confusion which is most puzzling to the reader, even if he be a skilled chemist; while, if he be not, the use of a '*trituration* of soda for the determination of nitric acid,' of chloride of *lime* for use in a drying-tube, of *ammonium* as a test for the solubility of silver chloride, and the method described for the *transmutation* of a gas into a burette, may well seem unintelligible.

Throughout the work, the author has sought to give due credit to the various investigators whom he quotes; yet we observe that in some instances he errs, as when he states that the experiments on explosive gelatine, which he describes, were made in France, when, in fact, they were made in Austria by Capt. Hess, the French account of them being simply a translation of Hess's paper by Paul Barbe. On the other hand, he erroneously credits Hess with the application of the various methods described for the quantitative analysis of nitroglycerine mixtures.

Many positive statements are made which may be questioned. Thus Eissler states that the explosions of the fulminates "are very sharp from the extreme rapidity of their decomposition, but, from the small amount of gas given off, the force exercised is not very great;" while Berthelot says, "Calculation will show that no other explosive known will give in contact an instantaneous pressure at all comparable to that of mercuric fulminate." Again: Eissler asserts that "nitro-compounds of cellulose with more than 41.89 % of NO_2 contain nitric acid in the pores which is not properly washed out." This percentage corresponds to the pentanitrocellulose, and the statement is probably based on Ecler's researches in 1879; but Vieille, in 1882, found that thoroughly nitrated cellulose yielded 44.27 %, corresponding to eleven atoms of NO_2 in the molecule. Other examples might be pointed out.

The above criticisms apply principally to the first third of the book. In parts ii. and iii., which are devoted to the mode of use and applications of the high explosives, the author appears more at home with his subject, which he presents in a clearer manner, and with greater precision of statement: and he has gathered material which must be of interest and use to the engineer and contractor. The perusal of this portion will also interest the general reader; as few realize to how great an extent, and for what a variety of purposes, explosive substances are used at the present day. Here he will learn that advantage is taken of the enormous potential energy of these bodies in the quarrying of stone; the mining of ores, coal, and oil; the driving of cuts and tunnels for roads; the deepening of our channels, and the removal of reefs and rocks from our harbors; the driving of piles; the clearing of fields for agriculture, and the shaking-up of the soil to prepare it for vegetation; the destruction of icy barriers, and the breaking-up of large masses of metal to fit them for the melting-furnace. The climax seems to be reached in the statement, that, in some of the hydraulic gold-mines of California, it is an almost daily occurrence to fire blasts in which twenty, thirty, or even fifty thousand pounds of explosives are used in a single charge, — an amount exceeding that used in the blowing-up of Hell Gate. Compared with this, the amount used for purely military purposes sinks into insignificance.

THE OHIO AGRICULTURAL EXPERIMENT STATION.

Second annual report of the Ohio agricultural experiment-station, for 1883. Printed by order of the state legislature. Columbus, *Myers brothers*, state printers, 1884. 207 p. 8°.

THE first impression made by this report is that of unusual industry in experimentation. A large amount of work has been done upon wheat and Indian corn, as was natural, considering the location of the station. Quite extensive feeding-experiments have been executed; and a number of minor subjects have received more or less attention, such as observations on garden-vegetables, fruits, weeds, and injurious insects, the testing of over five hundred samples of seeds as to their germinative power, experiments on cutting potatoes for seed, etc.

Over forty pages are devoted to experiments upon wheat, and nearly as many to those upon Indian corn; such subjects being considered as the comparative value of varieties, thick and thin seeding, winter protection and spring cultivation of wheat, planting at different depths for corn, methods of culture, application of fertilizers, etc. Some interesting experiments in crossing different varieties of corn are also in progress.

The feeding-experiments relate mainly to milk-production, though a few pig-feeding trials are added; showing that the same amount of food produces more rapid growth when the animals are protected from extreme cold, — a fact which has already been proved so often, and which is so fully in accord with all that we know of the effects of a low temperature on animals, that it would seem that it might now be accepted as established.

The experiments presented in this report are so good, and represent so much labor, that one can but regret that they are not better. For example: the field-experiments on wheat and corn give evidence of care in planning and in execution. They take up important subjects, and present much food for reflection to farmers; but in all candor it must be said that they *prove* nothing. Passing over the question which is now being seriously asked by eminent authorities, whether field-trials are capable of yielding trustworthy results, it is certain, that, in order that they may do so, they must be executed with all the precautions which the experience of thirty years has suggested. It is not too much to say that these experiments are not thus distinguished, though they do, indeed, compare favorably with many others; and when we find, for example, the two unmanured plots of one series yielding respectively 40.2 and 70.4 bushels of corn per acre, we must conclude that the results of such trials are to be taken with some grains of allowance. The feeding-trials, too, while in many respects carefully conducted, have just enough elements of uncertainty — short periods, estimates of amount of hay eaten, estimates of composition of food, etc. — to give rise to the constant feeling that the results may be accidental.

It is, of course, to be presumed that this station, like most others, has not the means to do all that its director would be glad to do; and a fair criticism should take into account the limitations under which such work must usually be done. At the same time, certain conditions are essential to the prosecution of scientific research; and experiments made in disregard of them are no better because that disregard is enforced.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF GEOGRAPHY.

THE meetings of the section were held in the Montreal gymnasium, which was sometimes crowded to overflowing, especially upon the appearance of Lieuts. Greely and Ray.

The president's address was listened to with marked attention. After the usual formalities were passed, the proceedings were opened by the president, who communicated a letter which he had received from Mr. Joseph Thomson, — recently returned from Africa, — from which the following is extracted: "I shall have to tell about snow-clad mountains, grassy plateaux, and sterile plains, of picturesque isolated mountains, wonderfully preserved volcanic cones and craters in which the fiery forces might have been at work the previous year, of the charming crater-lake Chala on the slopes of Kilima-njaro, the silvery sheets of Naivasha, Mtakuto, and Baringo, lying embosomed in a great valley-like depression formed by the dark and frowning mountains of Man and Lykipia. Not the least interesting subject will be that of the enormous volcanic mountains El Gon or Ligonyi.

"The people themselves are more interesting and unique than their country. The Masai are in every respect a people by themselves. They have no resemblance either to the true negroes or to the Galla and Somal who shut them in. They distinctly differ in their mode of life, their curious customs, forms

of government, and religious belief, not to speak of their curious language. I am happy to say that I have been able to determine the latitude of all points of interest by astronomical observations, as well as the longitude of Baringo and Kwa-Sunda near the Nyanza. The height of all main points has been determined by George's barometer.

"My route was from Baringo to near the Nile, almost due west, returning somewhat farther north. Kavisondo does not extend so far south, not more than 20′ south. The north-east corner of the lake, as represented on the maps, must be cut off if my observations are correct." A spirited discussion ensued, in the course of which it appeared that Mr. Thomson had had some hairbreadth escapes, and had endured the extremity of hunger. Professor Ravenstein gave a description of the physical conformation of equatorial Africa, and said that the Masai were no new race, but had been met with before. He instanced the Latooka of Sir Samuel Baker, and M'tésa, the chief of Uganda, and quondam convert of Stanley, as belonging to the same group.

The president made a communication with regard to Mr. H. H. Johnson's Kilima-njaro expedition, to the effect that he had been well received by the ruler of the district, 'King Mandalla,' and had been given every facility for the prosecution of his work of collecting specimens of natural history.

Prof. E. G. Ravenstein, the recorder of the section, read an exceedingly interesting paper on certain maps and globes of Central Africa before the seventeenth century, which exhibited a complicated river system and a congerie of lakes. It had been supposed by certain geographers of eminence, including Mr. Major, that the hydrographical features were derived from actual knowledge obtained by the Portuguese, who had thus anticipated Livingstone, Cameron, and Stanley by a couple of centuries. But this was not a correct idea; as the learned Ludolfus — if he had carried out his intention of compiling a map of the whole of Africa — would have shown, and would thus have gained a place among cartographers second only to Delisle and D'Anville.

In order to judge how far these ancient maps were based upon actual knowledge, or were merely conjectural, it would be necessary to examine the records of early exploration; and, fortunately, we are now in a position to do this, as Luciano Cordeiro had brought to light several of the most ancient Portuguese records.

After a concise account of the explorations of the ancients, Mr. Ravenstein narrated, at some length, the exploration carried on by the Portuguese. He said that their knowledge of the coast districts was pretty full; and as early as the sixteenth century they had heard of the Makoko, the great chief of the Anteke, as well as of several tribes on the middle Kongo, of the Zambeze as far as Chicova, and of a considerable portion of Abyssinia. Inland lakes were mentioned by them, but in so vague a way that their identification with our modern lakes was impossible. Even the Nyassa seems to have been unknown to them, although merchants from Sena navigated the Shiré; and an overland trade was undoubtedly carried on by the natives, for articles of Portuguese manufacture actually reached Manica overland from Loanda. But no Portuguese had ever crossed the continent; as Gregorio Quadra and Balthazar Rebello de Aragão, who attempted to do so in 1520 and 1602, had failed at the very outset.

With regard to the ancient maps, he stated that the earliest among them were mere repetitions — so far as the interior was concerned — of Ptolemy. Later on, the remarkable information given by Fra Mauro on Abyssinia was embodied in them. Ruysch's map (1508) is an illustration of Ptolemy; and if we took the more detailed maps of the period, — Pigafetta, illustrative of the 'Congo,' for instance, — and transferred the names there found to their correct position, we should find that the interior of Africa was a blank. As an example, Barcena, Coloes (from Ptolemy), Zahaf, and Saphat were names all referring to the great lake of Abyssinia, our Lake Tsana.

It followed from this, that, up to the beginning of the seventeenth century, the Portuguese had no knowledge of the centre of Africa and of its great river-systems; although subsequently they had made certain discoveries which anticipated, in a measure, the information obtained by the heroes of modern African exploration.

Mr. Trelawney Saunders described the remarkable journey of a trained native of India — Krishna, or A. K., as he is more commonly called — who penetrated regions hitherto known to us only through D'Anville's *Atlas de la Chine*, which contains maps of Tibet, derived from the surveys of Lama priests, made in continuation of the great Jesuit work, under the orders of the famous emperor Kuenten. It has been all along a most interesting feature of the researches of the native explorers in Tibet, that they have, in a remarkable degree, confirmed these Tibetian surveys, allowing some little differences easily recognized. In the present case the explorer, leaving Prjevalski's route at a point near the source of the Hoangho, struck a river, which, on placing a reduction of his work upon a reduction of the Lama survey, on the same projection and scale, falls exactly, without any exaggeration, upon the course of the Murus Ussu, or upper waters of the great river Yang-tse-Kiang. Nevertheless, the conclusions adopted in Calcutta make this river to be the Yalung, one of the great affluents of the Yang-tse-Kiang.

After some little discussion of a rather desultory nature, — in the course of which Mr. Gordon, an engineer who has travelled extensively in India, asserted that the country on the Bacco, where about six hundred inches of rain fall in a year, was the rainiest in the world, — Mr. Saunders described the first general census of India, which was taken on Feb. 17, 1881. The entire population enumerated was 253,891,821, occupying an area of 1,382,624 square miles. He then compared various parts of this large population with that of other countries chiefly European, and described the Indian house and its contents. This census, which is embodied in twenty folio volumes,

contains reports under the following heads: area of population; movement of population; religious classification; proportion of sexes and religious divisions; condition of population; condition and age of population by religion and province; birthplaces, insanity, deaf-mutes, occupations, languages, education, blind people, lepers, castes. The reports in general are not merely a dry record of figures; but they abound with information of a most interesting character, concerning this grand division of the population of the world, which stands second only in number to its still vaster neighbor, the empire of China. It may be useful to add that an abstract of this census may be obtained in three volumes.

The president of the section, Sir J. Henry Lefroy, spoke of the value of the census, and enlarged upon the fact that it showed that there were nearly two million native Christians in India. In answer to a question, Mr. Saunders said that of this large population but 89,000 were natives of the United Kingdom.

The next paper was on Mount Roraima in British Guiana, by Mr. E. F. im Thurn, for some time a magistrate there, who proposes to examine the mountain as closely as possible on every side, and to make the ascent, should circumstances permit. He intends, moreover, to examine and collect the flora and fauna of the country, and especially to investigate the condition of the little-known Arecoona Indians in whose district Roraima lies.

In conclusion, the recorder of the section, Prof. E. G. Ravenstein, read an exceedingly suggestive paper on the proper method of teaching young children the rudiments of geography. He said that the time when teachers of geography confined themselves to teaching their pupils a barren list of localities was fortunately past, and the principles first enunciated by Pestalozzi and Fröbel might be said to have taken a fair hold. But still the geographical text-books were far too abundant in nomenclature, as distinct from an exposition of facts or an explanation of phenomena. Elementary geography should teach our children to understand the locality in which they live, to observe, and to think for themselves, instead of accepting the definitions presented to them; to describe, further, their experiences in language of their own, instead of paraphrasing the language made use of by their teachers. This method compelled us to take our children out of the schoolroom, and to bring them to the locality which it was desirable to describe. The lesson which followed would be really an object-lesson, which lessons based on a map or a picture or a model could not be. The children should be encouraged to observe the same phenomenon repeatedly until they have obtained a clear conception of it. The children would then observe the fact under consideration once more, with such help as would be afforded by the teacher's explanation; and to this would succeed a final consideration of the subject, within the schoolroom. The subjects of this elementary study ought to include the surface features of our earth, its vegetation and fauna, and its inhabitants. Atmospheric phenomena, as well as the celestial bodies, in as far as their movements are visible from our earth, should also be included. He would include the elements of geology and of natural science generally, in so far as they would explain geographical phenomena; and, besides, he would seek an opportunity of expounding the principles of political economy and of statistics. The range was, therefore, a wide one. The subjects would differ according to the locality in which the school was placed, as during the earlier stages the children would be limited to subjects coming within their sphere of observation; and only at a more advanced age, when the power of imagination had been developed, would they carry the young mind from things seen to things unseen. Thus a consideration of the St. Lawrence and its turgid tributary, the Ottawa, would carry them in course of time to the great lakes, and to the magnificent forests, which explain the color of the water of the rivers. The various phenomena would not at first be considered systematically, but as occasion arose.

This paper was followed by an interesting discussion; during which it was remarked, that the main difficulty in introducing such a method into the school boards of England was the examination system there in vogue; as it was necessary for teachers, if they wished to retain their places, to cram their pupils for the examination. May not some such vicious system be the cause of the gross ignorance on geographical subjects which prevails in our own country?

Mr. James Glaisher read a report of the committee for promoting the survey of western Palestine. He first gave a brief history of the 'Palestine exploration fund,' which was founded in 1865 with the object in general terms of obtaining from the Holy Land itself whatever facts might be gathered for the elucidation of the Bible. The work was classified as follows: 1. Archeology — including excavations; 2. Manners and customs of the modern inhabitants; 3. Topography; 4. Geology; 5. Natural sciences, botany, zoölogy, etc.

The first work undertaken was the excavation at Jerusalem, which occupied the years 1867–1870, and threw a flood of light upon the ancient city. In 1870–1871 a journey was made through the Desert of the exodus; and in the autumn of 1871 the survey, on the scale of an inch to a mile, of western Palestine, was begun. The work was carried on until 1875, when the party was attacked by the Arabs. In 1877 it was resumed; and in 1880 a map in twenty-six sheets was published, followed by a reduction of it on one-third scale in 1882.

In 1882 the survey was extended to the east of the Jordan, but owing to the opposition of the natives was abandoned after only about five hundred square miles had been surveyed. The society is now waiting for the Sultan's firman, without which Mr. Glaisher stated no alien is allowed to remain more than one month in the country, to go there with a camera, or to take away the smallest specimen. He then gave a short account of the results of the geological survey conducted by Professor Hull last winter, a full account of which is now in press.

Dr. J. B. Hurlbert said that by comparing the climates of different portions of the two hemispheres, — western coasts with western, eastern with eastern, and interior divisions with interior, — it was found that vast areas in the new world possessed soils and climates similar to corresponding regions of the old. With regard to the coasts, this was due to the oceanic currents. As to interiors, they had warmer summers and colder winters than oceanic regions; and in the central part of North America, between the parallels of 30° and 50° north latitude, there was but little rain in summer, and much snow in winter. This summer drought was due not to the Rocky Mountains, as many had supposed, but to the prevalence of south-west winds. The operation of these winds was described in detail, and it was asserted that trees could not be induced to grow in that arid waste, and that the prairie once broken up could not be reset. The reverse of all this was true of the interior of Canada. He closed by remarking that climates have as powerful an effect upon the human race as upon vegetables; and that, therefore, the people of this region of great summer drought would in time become like the Bedouin Arabs; while Canada would be the future great power on the continent.

Dr. Hurlbert then read a paper on some peculiar storms. He began by saying that he did not believe in the existence of cyclones, although he admitted the existence of whirlwinds in the West Indies. But he thought that the hurricanes which swept our eastern coasts were due to a warm current of air, which, starting from the Gulf of Mexico, proceeded in a northerly and easterly direction, and, meeting with a cold atmosphere, condensed. Into the vacuum thus formed, air poured from every side, and the storm swept on with ever-increasing violence.

Dr. Ball said that he thought that Dr. Asa Gray would hardly agree with the learned gentleman's deductions with regard to the future of vegetation in the region of summer drought, and reminded him that it often rained there when least expected, and hinted that averages of rainfall, etc., were likely to be misleading. He also asked him some questions as to the climate of the coast of California, to which no satisfactory explanation could be given.

Mr. Trelawney Saunders then severely criticised the unscientific method pursued by the Dominion survey, borrowed from that of the United States survey, which had been devised in times of geodetic darkness; and he advised a method of division of the land by meridians and parallels, which was shown (the next day) by Mr. Leslie Russell of the Dominion survey to be precisely the method pursued by that survey. As to Mr. Saunders's criticisms on the lack of orographic information furnished by the maps of the survey, Mr. Russell replied that the differences in elevation were so slight in the region now being surveyed, that it was impossible to show them by any ordinary means; and that, besides, it was necessary that the territory should be laid out into sections, townships, etc., as soon as possible, that settlers might go there and take up land without fear of future litigation as to boundaries and titles.

On the fourth day Lieut. P. H. Ray, U.S.A., after describing the objects of the circumpolar expeditions, gave an account of the explorations and observations undertaken by him at Point Barrow, Alaska. He said that the ground never thawed to a greater depth than twelve inches; and that two years' careful observation had satisfied him that there is no open polar sea, from the fact that the temperature of the sea-water is unvarying from the time the sea closes in October until it opens in July, which could not well be the case if there were a large body of warm water lying around the pole. Besides, the atmospheric conditions were found to be such as would not exist near a large body of open water. In addition, all discoverers had noticed, that, although a current runs *to* the north, nevertheless the sea is filled with old ice, which he thought came *from* the north, and this could not happen if there is an open polar sea. In concluding he said, that, in laying out the work for the circumpolar expeditions, the magnetic pole had been neglected, which was a great mistake; and he declared that he would willingly go there himself.

The president of the section, in introducing Lieut. Greely, said that his party had helped to solve one of the most difficult geographical problems of the day, and that Lieut. Lockwood had reached the farthest north; that they had furnished data for determining the compression of the polar axis, by observations nearer the pole than any hitherto made; and that they had brought home the pendulum used, that it might be corrected at Washington. He thought that nothing in the annals of scientific heroism exceeded the devotion of those hungry men in sticking to that ponderous piece of metal. Lieut. Greely's paper descriptive of the work of the expedition has been extensively printed; and there is no need of mentioning here more than a few points which, indeed, were supplementary to the paper itself. He said that at Fort Conger the ground thawed to a much greater depth than at Point Barrow, namely, between twenty-nine and thirty-four inches; and that with regard to an open polar sea he believed in the existence of an open, but not necessarily navigable, sea in that direction. He said that he had only been at his station a short time when it struck him that he could tell whether the tide was flowing or ebbing, by the temperature of the water; and by observations he found that when the tide came from the north the water was warmer than when it came from the south. The tide travelled with great velocity; and most perfect observations had been made at different points, in many cases simultaneously, which would be published in due season.

Capt. Bedford Pim, in offering his congratulations to the explorers upon their safe return, said that he was glad that Lieut. Greely agreed with him as to the existence of a *polynia* in the vicinity of the pole, and he hoped that Lieut. Ray would be brought to their way of thinking.

It seemed to be the opinion of all the speakers, that arctic exploration should be continued, and that it was especially important that the magnetic pole (of

which Capt. Pim declared no one knows the position) should be visited, and a large number of accurate observations there taken.

A lunch was given to the two lieutenants in the afternoon, but nothing was then said of geographical importance.

Mr. R. G. Haliburton said that he considered the saga of Eric the Red, describing the voyage of his son Leif to Vinland, a poetic version of Bjarne's voyage reversed. Eric, driven from Norway, and afterwards from Iceland, discovered a dreary country, which he called Greenland, avowedly to attract emigrants thither. Subsequently the land sighted by Bjarne, and visited and colonized by Eric's family, was called by them, evidently for the same object, *Vinland the Good*. The length of the shortest day, the presence of Eskimos, the Norse maps, and geographical notices, all show that Vinland could not have been south of the north-western part of Newfoundland.

Mr. Haliburton also said that recently discovered Portuguese documents prove that the next oldest colony in America was *Terra nova*, embracing Labrador, Newfoundland, and Nova Scotia, which was explored by the Corte Reals in 1500–1502; and that commissions were regularly issued to them as governors up to 1579. In 1521 a patent was issued to Fagundes of all the lands between the Spanish colonies and 'the land of the Corte Reals.' He had recently discovered, while in the Azores, that two Portuguese colonies sailed thence to Cape Breton in 1521 and 1567, probably to St. Peters and Ingonische. The Spaniards, who annexed Portugal to Spain in 1580, sent a colony to Spanish Harbour (Sydney) between 1580 and 1597. He added that Cape Race (*Cabo raso* — 'bare cape'), the Bay of Fundy (*Fonda* — 'deep'), and other Portuguese names, still tell of this 'lost colony.'

The Rev. Abbé Laflamme then said, that the province of Quebec may be divided into two hydrographic basins, — that of the St. Lawrence, and that formed by the collection of lakes which fed the rivers flowing into Hudson's Bay. The name of only one of these lakes was known, — lake Mistassimi. It was certain, however, that there were many others of great size in its vicinity and on the peninsula of Labrador. He declared that all the maps hitherto published of lake Mistassimi were inexact. One thing only was certain, and that was, that it was larger than lake Ontario.

Professor W. Boyd Dawkins maintained that the former connection of North America with Greenland, Iceland, and north-western Europe is most conclusively proved by the distribution of the fossil plants and animals in the eocene and miocene ages. The tract of comparatively shallow water ranging from Greenland past Iceland to the Faroës and northern Scotland, and which isolates the deep waters of the Arctic sea from the depths of the Atlantic, formed the bridge across which the migration took place, the four-hundred-fathom line representing approximately the line of the ancient shores. The barrier became submerged towards the close of the miocene age; and then, for the first time, the Arctic waters united with the Atlantic, and arctic shells gradually found their way southwards into the area of the British isles.

Mr. J. S. O'Halloran then presented a memorandum with regard to Winnecke's exploration of central Australia, with notes on the employment of camels, and some extracts from his journals. The reference to camels reminded Mr. Torrance that they were formerly employed in British Columbia, but that the smell of the beasts so terrified horses that the government ordered their use to be discontinued.

The president of the section then made some remarks about the poor attendance at some of the meetings, — at one time there were but four persons present, besides the officers and reporters, — which he attributed to the unfortunate position of the building in which the meetings were held; and the section was then adjourned.

PROCEEDINGS OF THE SECTION OF ECONOMIC SCIENCE AND STATISTICS.

THIS section has been in existence almost from the foundation of the British association, having been organized as a section of statistics in 1833: economics were added in 1856. The range of topics considered has been very wide, and has included such topics as population, mortality, emigration, labor, crime, punishments, debt, wealth, trade, coinage, banking, insurance, poor-laws, schools, libraries, sanitary regulations, water-supply, pollutions of rivers, forestry, agriculture, stock-raising, imports and exports.

The section assembled at eleven o'clock on Thursday, in Synod hall, several blocks distant from McGill college, where most of the sections were located. Nevertheless, about 140 persons were present to listen to the address of the sectional president, Sir Richard Temple, of London, upon the general statistics of the British empire.[1] It was noticeable that the applause occurred when reference was made to the superiority of Great Britain, and but once when comparisons showed the United States to be superior to the empire. A vote of thanks was proposed by Prof. J. Clark Murray, of Montreal, and was supported by Mr. Edward Atkinson of Boston, who highly complimented Sir Richard Temple for his efforts in founding the school of British economical science. Professor Murray thought this section would be more interesting to Canada than any other; because, 1° it was not so abstruse, and 2° it treated of matters of vital importance to Canadian voters. He hoped soon to see a chair of economic science in McGill college.

Sir Richard Temple said he would accord the place of honor to the United States, and called on Mr. Atkinson to read the first paper, entitled 'What makes the rate of wages.' Mr. Atkinson said that the argument of Mr. Henry George in his 'Progress and poverty,' that the rich are growing richer, and the poor

[1] The address is printed in abstract in *Science* of Sept. 5, p. 234.

becoming poorer, as a whole, was not conclusive, and that the extraordinary circulation of the book in many languages showed how all-important was the question at this time. He therefore suggested, in reply, that, as it is generally conceded that somewhere and always there is enough and to spare, the question is only one of distribution, not of production. And yet distribution he held to be subsidiary to production, claiming that at no time should more be distributed than was produced in that period. That distribution is to 1° taxes, 2° profit, 3° labor, — the last receiving all that the others leave, and being measured by wages. The true wage which is due to the laborer is food, fuel, shelter, and other means of subsistence. The vast majority of mankind are wage-receivers. What determines the rate of their wages in terms of money? *High rates of wages are the natural and necessary result of low cost of production.* Especially is this so in the United States, where the people are homogeneous, means of intercommunication ample, and where there is no artificial obstruction to prevent commerce. Wages are therefore the consequence and remainder over after capital has received its profits. This remainder has been constantly increasing. This he illustrated by elaborate statistics, compiled from the books of two New England cotton-factories. The profits declined, having been 2.40 cents per yard in 1830; 1.18 in 1840; 1.11 in 1850; .69 in 1860; .66 in 1870; .48 in 1880; .43 in 1883; and .41 in 1884. The average annual wage per operator had increased at the above dates as follows: $164, $175, $190, $197, $240, $259, $287, and $290.[1] Profits and wages together showed a constant increase due to increased efficiency and subdivision of labor, improved machinery, and a consequent lower cost of production. Capital alone made this possible. Vanderbilt was pronounced the greatest communist in the United States, in that, for every cent he saves from his railroads, he saves a dollar to the masses in the cost of transportation, and thus aids a low cost of production, which, in turn, gives a high rate of wages. Mr. Atkinson incidentally pointed out, as against the Malthusian theory, that as yet a field ten miles square would hold the population of the earth, while one twenty miles square would seat every person; and that, but for the interdependence of nations, an enormous part of the products of our soil would rot as valueless. It is our duty to show the masses how, in the distribution, each may get his share; or, as Gladstone has said, to weave the web of concord among the nations.

The paper was discussed at length by Sir Richard Temple; J. B. Martin of London; Prof. H. S. Foxwell of St. John's college, Cambridge; Mr. Swire Smith, of the Royal commission on education, Lowfield, England; David Chadwick of London; and Cornelius Walford, the secretary of the Geographical society, London. The general tenor of discussion was highly complimentary to the essayist. Mr. Martin thought labor and capital unavoidably in opposition, not to say antagonistic; and that the rate of wages would be determined by the margin existing between the cost of wages and what the laborer is willing to confine himself to for a living. That margin which so attracts emigrants he found excessive on this continent, and was totally at a loss to explain why it required ten cents to get his boots blacked in Montreal.

Professor Foxwell said that in Ricardo's time capital was the starting-point for discussion; now it is labor. Gen. F. A. Walker has done much, by his political economy, to influence thought in England. In the distribution in question, every thing depends upon the *equality of the bargainers*. As laborers have become wiser, they have bargained for a better distribution. In the United States this has been potent. The diffusion of property as a reserve is a very important aid to bargainers. England much needs to educate its laborers, and secure a diffusion of property. Monopolies he had regarded with distrust, but is coming to think them desirable: they must, however, be under some public control and restraint. He pointed out that the rise in factory wages had been coincident with the rise of labor-unions, and doubted whether capitalists voluntarily raised the wages. Capital invested in factories was doubtless receiving a lower percentage of profit, but interest is also lower. Mr. Smith could see, in the facts presented, only Adam Smith's law of supply and demand regulating rate of wages. Mr. Chadwick demurred from the Smith doctrine. Disturbing elements have come in. By combination English laborers have forced higher wages, and the hours of labor per week from sixty in 1849 to fifty-six and one-half in 1884. Capitalists have always known their power: the laborers, only recently. Germans, French, and Swiss work sixty hours, solely because they do not realize their power, and combine for a reduction. Mr. Atkinson admitted that character, in the last analysis, makes the rate of wages. He thought, that, although legislation had attempted in Massachusetts to regulate hours of labor, the changes cited have come about naturally, and regardless thereof.

Three papers on savings banks followed. Mr. W. A. Douglass, of the Freehold and savings society of Toronto, gave the history and described the management of loan and savings companies in Ontario. Starting in 1855, the number has reached 73, with assets of $79,500,008. Seven per cent is obtained in Ontario, and nine per cent in Manitoba, on good mortgages. Since 1874 the companies have obtained some money from England, the amount so handled amounting to $25,679,803. Mr. Stephen Bourne remarked upon the opportunity thus presented for England to invest surplus funds, and of her duty to thus aid her colonies. Mr. Atkinson spoke of the 800,000 accounts averaging $300 each, in Massachusetts savings banks, and of the accumulations made by Irish laborers Mr. J. Cunningham Stewart, of Ottawa, sent a paper upon the history and progress of post-office savings banks, which contained the statistics of the subject from official sources. After sixteen years' growth, Ontario has 57,296 depositors, and Quebec 9,386. The deposits amount to $13,-245,000, one-half of which is held in Montreal and

[1] All figures are reduced to gold basis.

Quebec city. Mr. Thomas D. Tims also sent a paper on dominion savings banks. Vice-president Martin remarked upon these papers, deprecating the tendency of people to avoid making their own investments by intrusting them too much to such institutions.

A paper on Irish emigration was read in behalf of Mr. James A. Tuke, the founder of Tuke's emigration bureau. This paper graphically pictured the abject condition in Connaught and many Irish counties. Some 200,000 families, or 1,000,000 persons, occupy small holdings never taxed as worth over $20 to $50, and consisting of from one to ten acres of bog-land. This at best yields not over nine months' subsistence, leaving three months' dependence on charity. The least evil for remedying this state of affairs was found in emigration to America. At an expenditure of $68,500 he has aided 9,482 to seek a better home in the new world. Of this money, 220,000 was from the government, and the remainder private gifts. Over seventy-seven per cent were the young and healthy, but too poor to obtain transportation money for themselves. Once located, however, they have been industrious, and at once set to work to send back savings to their relatives, thus enabling them also to emigrate. Not less than $25,000 was so returned to Ireland in 1882 and 1883, one shop-keeper having cashed $1,000 of such drafts. Of the counties furnishing emigrants, seventeen per cent of the population was removed. The people were located in 165 different places, 148 in the United States, and 17 in Canada. Less than five per cent had ever uttered a complaint as to their new condition. The paper was discussed by Mr. John Lowe, Department of agriculture at Ottawa, and by Major P. G. Craigie of London, both of whom had observed the good effects of Mr. Tuke's work. The latter said, 'The Irishman will succeed best out of Ireland.'

Mr. W. Westgarth, president of the Melbourne chamber of commerce, read a paper on the British Empire in North America and Australia. He made elaborate comparisons between Canada and Australia, and furnished valuable facts, especially concerning the latter. He admitted that a drought had swept away ten million sheep, but said they had sixty-six million left. The dominion exports of 1882 were valued at $97,671,000; the Australian, at $255,000,000, chiefly consisting of wool and gold. Victoria has already exported £210,000,000 sterling in gold. The dominion has 9,000 miles of railway; Australia, 7,000 miles. Dominion annual revenue, $36,000,000; Australian, $110,000,000. Dominion debt, $153,661,000; Australian, $496,250,000. He urged the need of closer ties between Great Britain and her colonies.

On Friday, Vice-president Martin read a paper on media of exchange, or notes upon the precious metals, speaking of 1° the metals, 2° coin, 3° bank-notes, 4° instruments of credit. The discussion was participated in by Mr. Chadwick; Mr. Atkinson; Mr. Sidney Fisher, M.P.; Mr. Stephen Bourne of Wallington, Surrey; Hon. C. W. Fremantle, Master of the royal mint, London; and Dr. James Edmunds of London. The latter spoke of small bank-notes as a most serious media of infection, the germs of cholera, small-pox, scarlet-fever, etc., being retained therein. Coin may be disinfected by heat. The paper and the discussion included such topics as the advantages and disadvantages of coin, the supposed gold depreciation since the opening of American and Australian mines, the dangers from inconvertible notes, the improbability of changes in the English sovereign, the proper method of meeting the expense of converting bullion into coin, the blessings of a good banking-system, with allusions to those of the United States, Russia, and other nations. Dr. Edmunds regarded the value of gold as dependent on so many variables, that its actual value cannot be ascertained. Mr. Atkinson thought gold had lost some of its purchasing power, and Mr. Martin thought it had steadily increased.

Mr. Michael G. Mulhall of London, author of the Dictionary of statistics, read a paper upon the debts of nations. The debts of the leading nations in 1884 he reported in millions of dollars, as follows: France, 4,975; Great Britain, 3,780; Russia, 2,775; Austria, 2,540; Italy, 2,190; Germany, 1,670; Spain, 1,650; United States, 1,525; Spanish America, 975; India, 800; Turkey, 740; Australia, 580; Egypt, 565; Portugal, 535; Holland, 420; Belgium, 390; Japan, 335; Canada, 190; Roumania, 135; South Africa, 115; Norway and Sweden, 100; Greece, 90; Denmark, 60; Servia, 20. Grand total, $27,155,000,000. From 1848 to 1870, the annual increase averaged $99,000,000; from 1870 to 1884, $115,000,000. The increase, however, has not kept pace with the increase of wealth. Of existing debts, sixty per cent stand for war expenditure, and forty per cent for improvements; but of debts incurred since 1848, fifty-five per cent was for peace, and forty-five per cent for war. The paper was discussed by Mr. Walford, Dr. Edmunds, and Mr. Atkinson. The contracting of war-debts was severely denounced; and, although the essayist regarded debt as a convenient investment, as no injury to the working-classes, and as not to be feared, the tenor of criticism was decidedly adverse to these ideas. Mr. Atkinson especially criticised the bond-holder, if not also a producer, as a burden upon society. To ascertain what burden a national debt is, we should consider, not population, not accumulated wealth even, but the *annual national product*. Burden is in ratio to net savings. A people which cannot save any thing from the current product is unbearably burdened by a public debt. How many laboring men in Europe, he asked, can save twelve pounds per year? The U. S. debt, he said, had been reduced from eighty-eight dollars per capita to twenty-five dollars per capita. He claimed that it reached $3,000,000,000 at the close of the war, although the official debt statements never showed so much. There were outstanding and unaudited liabilities which made the difference. Before these had been adjusted, the debt had been reduced by a similar amount. He prophesied that the progress of this continent would compel Europe to disband her armies, and pay off her debts, in order to get upon a competing footing.

A paper sent by Mr. J. McLennan, upon Canadian

finances, was discussed by Mr. Stephen Bourne, Mr. Hale of Montreal, Mr. Atkinson, Mr. Thomas White, and others. Some criticisms of Canadian tariff-laws and the sale of public lands were made by Englishmen, and replied to with spirit by Canadians. The latter usually professed to be free-traders, but defended the tariff, as required by very peculiar circumstances, such as its proximity to the United States. The American theory of the subdivision of public lands was explained by Mr. Atkinson, who also illustrated public subsidizing of railroad schemes by the history of the Hoosac tunnel. The interest on this debt would alone pay for transporting the bread of New England from the far west to Boston.

Major P. G. Craigie, secretary of the Central chamber of agriculture, read a paper on agricultural production with special reference to the supply of meat. With an increase in the population of Great Britain since 1868 of 16%, there has been but 4% increase of cultivated area, 11% increase in cattle, and 24% decrease in sheep. Consequently the importation of meat has grown from 100,000 tons in 1868, to 316,000 tons in 1876, and to 450,000 tons in 1883. The total consumption in 1868 he placed at 1,374,000 tons, or 100 pounds per capita; in 1883, at 1,774,000 tons, or 112 pounds per capita. The paper was discussed by Professor William H. Brewer of Yale college, Mr. Atkinson, and others. Mr. Atkinson said he had tried in vain to ascertain the consumption of meat per capita in the United States. A year's supply of meat and flour had been assumed to include three hundred pounds of the former and one barrel of the latter. To move this year's supply from the west, its place of production, to Massachusetts, costs but one day's labor, $1.25. He also spoke of the negro rations — three and a half pounds of bacon and one peck of corn meal — as producing a given amount of force at the smallest cost of any diet among any people of the earth, the cost being but seven cents per day. The reason is that the 'hog and hominy' are peculiarly adapted to each other for ready and perfect digestion.

Professor John Prince Sheldon and Prof. W. Fream, of the Downton college of agriculture in Salisbury, read interesting papers upon British and Canadian agriculture, as did Prof. W. Brown upon Canadian agriculture. Papers by Gen. M. Laurie of London, John Carnegie, M.P., of Peterborough, Ont., and Sydney Fisher, M.P., had been prepared upon the agriculture of Nova Scotia, Ontario, and Quebec; but there was not time to present them, the section having been in continuous session for six hours. Propositions to prevent the entrance of cattle-disease from the U. S. were repeatedly made and favorably received. It was shown that the acreage in Great Britain devoted to wheat and corn is constantly decreasing, and that to grass and pasturage increasing. Farm-rents are declining, and must continue to decline. Railway charges there are exorbitant. Wheat can be brought across the ocean cheaper than from some counties by rail. Several gentlemen discussed the papers. Peter Price, an English landowner, uttered his astonishment at what he had seen here: his best tenants are leaving him, and he cannot rebuke them. His estate of three hundred and fifty acres is going into pasture, and he cannot get enough out of it to pay taxes. The thrift of Canadian agriculturists and the embarrassments of Great Britain were brought out in the most striking manner, much to the satisfaction of Canadians, the amazement of the British, and the amusement of Americans.

On Monday a paper by Mr. Stephen Bourne was read upon the interdependence of the several portions of the British Empire. After presenting some statistics, Mr. Bourne entered upon an exhortation to the colonies to combine with the mother country in refusing to buy from nations which enforce protection. 'We should,' said he, 'teach the nations that we have a world of our own.' He would not answer protection with protection, but with absolute cessation of trade with those who are not 'fair-traders.' Sir Richard Temple suggested that England could not, so far as now known, get its long-staple cotton anywhere but from the United States, a high-tariff nation. Mr. Chadwick denounced the proposition, and said the author dare not make it, were the section in session in the British isles. 'This,' he said, 'would starve half our people and half our cattle' The president felt called upon to defend freedom of speech, although not agreeing with the speaker. Amid much excitement the Canadians rushed to the defence of their tariff, and openly declared that if they must choose between such an alliance with Great Britain and one with the United States, they had much to gain and little to lose by choosing the latter. Mr. Atkinson indicated the satisfaction which the United States might feel at such an arrangement. It would keep her products at home, glut the market, make labor much cheaper, and so reduce the cost of manufactured fabrics. She would then be able to compete in the world's markets, as she cannot now with English manufacturers! Mr. Thomas G. Haliburton said the foreign trade of England was decreasing, and that at the present rate of decrease but twenty years were needed to terminate it: hence the need of wise dealings with the colonies and foreign nations. Mr. Roswell Fisher of Montreal said such a policy would not do for the dominion. 'We Canadians exist here on the sufferance of the United States' [loud shouts of No, No!]. Should England retaliate upon the United States, it could crush Canada with a prohibitory tariff. But politically and socially Canada was nearer the latter than the former. No number of ocean telegraphs and swift steamers can destroy American unity [great excitement]. Sir Francis Hincks, a Canadian politician of fifty years' experience, being loudly called for, said, 'Let well alone.' Canada does not want representation in the British parliament and in army tax-lists, nor is she interested in her Majesty's foreign policy. He emphasized American friendliness, and the necessity of meeting the tariff of the United States wisely.

Mr. R. W. Cooke Taylor, inspector of factories, Treston, Eng., read a paper on factory acts. These are for the protection of women and children. Mrs.

King and Mrs. Hallett discussed the paper, expressing dissatisfaction with the act, and saying women could take care of themselves. Mr. Robert C. Adams of Montreal read a paper on the phosphate industry of Canada. In 1883 it amounted to 17,500 tons. Phosphate lands have sold as high as $1,250 per acre. Mr. Hughes, Mr. Martin, and Sir Richard Temple discussed the paper. A valuable paper on the fisheries of Canada, by Mr. L. Z. Joncas, was read by Mr. Thomas White, M.P.[1] The paper was discussed by Mr. Cornelius Walford and Mr. C. W. Smiley of the U. S. fish-commission. Several forestry papers closed the sitting, — Professor Brown of Ontario, on the application of scientific and practical arboriculture to Canada; Mr. J. P. Hughes, on the necessity of forest preservation; Mr. A. T. Drummond of Montreal, on the distribution of Canadian trees; and Mr. F. B. Hough, on the future policy of the forest management of the United States. Mr. Walford remarked that forest culture in England pays four per cent profit, and in the United States seven per cent. Mr. Caruthers of the British museum also made remarks. The anthropometric committee presented a printed report, including observations on eyesight by Mr. C. Roberts. This report contained valuable tables. On Tuesday Mr. Cornelius Walford spoke upon land and water communication. Mr. E. Wragge and Alexander McDougall presented a joint paper upon the same topic. A paper by Emile de Laveleye, upon land laws, was read by the secretary. Miss Maria Rye, Mrs. Burt, and Mrs. Joyce each read a paper on female emigration. C. Le Neve Foster read a paper on the relative dangers of coal and metal mining. Many of the papers were presented by the authors in printed form, and printed abstracts of many others were circulated.

PROCEEDINGS OF THE SECTION OF MECHANICAL SCIENCE.

THE mechanical science section of the British Association appears to be in a prosperous condition, as was intimated, indeed, in the opening paragraph of the address of its president, Sir Frederick Bramwell: this is due, no doubt, to the fact that its scope is much wider than its name implies. The president's address was instructive as well as witty; it was in the form of an apology for the practical character of the section, and exhibited in detail the interdependence between it and the others, showing it to be complementary to them; but the distinguished author did not fail to scatter valuable suggestions throughout, and to indicate some lines of past and future progress. The address, however, contains no carefully digested summary of engineering progress for the past year or up to the present time; and though many valuable papers, prepared by request, summarize progress in particular directions, the general scientific reader must seriously regret the fact. The various criticisms upon the hampering action of the government toward engineering enterprises, such as electric lightning, the telephone, the Channel tunnel, brought out the strong feeling of the English members, that the government should confine itself to governing. The courtesy shown the president in the delivery and acceptance of his address was a pleasant feature: the presidents of the association and of the physical section, as well as the sectional vice-presidents and secretaries, were upon the platform, and the former moved a vote of thanks. In doing so Lord Rayleigh commented upon the Channel tunnel and other government interference; and was followed by Vice-president Thurston, who seconded the motion, expressing the American sympathy with the obituary notice of William Siemens, and cordially inviting the members to take part in Section D at Philadelphia.

The multiplication of section officers is to be noted; there being no less than eight vice-presidents, four secretaries, and a large sectional committee, among whom appear the following gentlemen from the United States: Messrs. Coon, Emery, Hoadley, Leavitt, and Woodbury, and Professors Barker, Bell, Rogers, and Webb.

Many of the papers read were 'progress papers,' containing masses of detail of little interest to the general reader. The importance and extent of some of them render it a matter of regret that they were not generally in print, and that they were presented in so hurried a manner. In many cases, an abstract setting forth the main features of the paper, and comparing and emphasizing the main facts, with illustrations and graphical representations of results, would be far more effective when time is limited; and though such abstracts involve labor, they are of great permanent value to the paper.

The papers were classified as follows: First session, civil engineering; second, mechanical engineering; third, electrical papers; fourth, miscellaneous. Some of them were prepared by request to describe American practice, and some attempt was made to have comparative English papers.

Mr. B. Baker described the Forth Bridge. The expected cost of this enormous structure is £1,600,000. Excluding the half-mile of approach viaducts, the bridge will be over a mile long, consisting of three cantilevers, each over 1,500 feet long, and two connecting trusses of 350 feet each. Cantilevers stand on the two (Queensferry and Fife) banks, and one rests on the only island (Inchgarvie) midway; they are to be 340 feet high by 130 wide at their centres, tapering to 40 feet by 35 at their ends, where they sustain the ends of the connecting trusses. The material is steel, to be put together (after the English fashion) by riveting as each plate is placed in position. Work is now being done on the piers, and some steel is ready for the superstructure; nearly 50,000 tons will be required. The bridge leaves two arched water-ways of 1,700 feet, with 150 feet clear central height at high water, and a half arch at each side. It was commenced about twenty months ago, and no difficulties are anticipated. Fourteen vessels, seventy-two steam and other cranes, and twenty-eight steam-engines, with numerous special machines,

[1] This paper will be published in the U. S. fish-commission bulletin.

are used in its construction. Each of the three main piers consists of four masonry columns, 70 feet in diameter, upon rock or hard clay bottom, centred at the corners of a rectangle 270′ × 120′. The deepest foundation will be 70′ below low water, which makes it 110′ high, allowing 20′ for the tide, and 20′ more above high water. Add to this 340′, and we have 450′ total height. There need only be added a central observing-tower or flagstaff to make it the highest structure in the world. Attention is called to the difference between English and other contractors: the former are "not much accustomed to pneumatic appliances, other than an ordinary diving-dress, and rarely resort to them." No use has been made of pneumatic apparatus already provided, but for the deepest piers compressed air will doubtless have to be used. The compression members of the bridge are tubes formed of bent steel plates riveted together. Compression joints are planed to fit, and forced together before riveting; and holes for rivets are drilled, not punched. The tension members are box-girders riveted up. A large number of experiments have been made to settle doubtful points, notably as to wind pressure, regarding which reliable data were wanting: in so large a bridge, the weight of trains is of little importance as compared with that of the structure and the pressure of the wind. As it must be a problem of some difficulty, to join the members of such a structure in a substantial and artistic manner, it is to be regretted that the details of the joints were not shown, and that no judgment can be formed of their merits. Altogether, though the proportions of the structure may not be pleasing, they cannot fail to be imposing; and the truss principle will hereby, as regards possible span, be placed for the first time abreast of the suspension cable.

The discussion participated in by Messrs. Hannaford, Leavitt, Emery, and Webb, brought out the relative costs per foot — £200, £160, and £75 — for this, the Victoria, and the International bridges; the latter two having only a single track. Steel was stated to be cheaper than iron; and many questions were asked as to the constitution, properties, etc., of the steel used, to which there was no time for suitable reply.

A paper on the Severn Tunnel Railway, by J. C. Hawkshaw, naturally followed. This tunnel, commenced in 1873, and nearly completed, is four and one-third miles long, and will save over two miles of ferriage. It is a twenty-five-feet hole, lined with vitrified bricks made from the excavated material, and laid in Portland cement. It passes principally through marl and coal, full of fissures. At the lowest point its roof is forty-five feet below the river-bottom, over which flows the water sixty feet plus a tide of thirty-six feet. To reach this depth we have slopes of over one per one hundred. Much trouble has been caused by water. In one instance the wells for miles round were dried, and a river nearly disappeared; at another, a sixteen-foot hole broke through the river-bottom; in fact, there has been a succession of floodings and cavings-in, and the work is a monument of perseverance. Pumps have been added until there are now eighteen, with a capacity of forty-six thousand gallons per minute. There have also been radical alterations of the original plan. When Sir John Hawkshaw was appointed engineer in 1879, he lowered the whole tunnel fifteen feet, necessitating a new driftway. The driftways were commenced from several shafts; and there are now twelve shafts about fifteen feet diameter and from seventy to two hundred and twenty feet deep. Electric lights are now used, and compressed air has been employed for drilling and ventilation, though now air is forced through the entire distance by an eighteen-feet-diameter fan. The cost of the work is not known, and it is difficult to believe that much time and money might not have been saved by employing, from the start, a properly planned pneumatic process; indeed, the extra fifteen feet depth of the tunnel below the river-bed would seem to be a permanent disadvantage which might thus have been avoided.

Three railway papers followed. The first, by W. K. Muir, on single-track railways, was a condensed statement of the construction and method of operating a railway in America, where but a single track can be afforded. General plans of stations and crossings were given, and an infinite number of details alluded to as necessary to safety, comfort, and economy. The numbering of the hours from one to twenty-four was advocated. Much was said upon modes of signalling, and an improved signal-lamp described. It was claimed that white and red signals were sufficient, it being safer to exclude green. In the discussion it appeared that an economy is effected by strengthening cars so that they can be loaded full: formerly grain was carried two and a half feet deep, now four is customary. The American method of making up a time-card was explained, where the trains are represented by threads stretched over a board ruled one way for time, and the other way for distance. Mr. Preece spoke of the safety on railways: the safest place in England is supposed to be a first-class carriage between London and Edinburgh. The president advocated running trains by telegraph from a central station, there being absolute safety with but one train on the track at a time. This caused reference to be made to a Paris incident, where an unusually long train, going round a loop, ran into its own tail. Sir James Douglass spoke of the excellency of American head-lights, and advocated a mechanical signal-lamp to save time; to which was replied that the American train-man was quick, and a wiggle or two of his lamp was enough.

Mr. J. H. Wilson's paper on American permanent way referred more to the construction of the line, forming therefore a complement to the last. The qualities of a perfect track are good surface and drainage, and straight or truly curved track, of accurate width, well fastened and with tight joints. American rails rest with broad flanges on wooden ties; while English rails are reversible, and rest in iron chairs, so that ties can be placed far apart. Wooden ties, being plenty here, should be laid only two feet apart. Engines weigh from forty to over sixty tons. Detailed specifications for rails, etc., ac-

cording to the best practice, are given: ninety per cent of the rails must be thirty feet long, and a test piece must be furnished from each charge of steel. These specifications, and the rules by which rails are temporarily or permanently rejected, are elaborate and exact, and must result in a uniformity of quality and composition leaving little to be desired. In track-laying, the rails must meet within $\frac{1}{16}$ inch in summer, and $\frac{1}{8}$ inch in winter. Considerable space is devoted to ties, ballast, switches, frogs, crossings; and attention is called to the importance of the block-system, Westinghouse air-brake, interlocking switches, etc.

Mr. Vernon Smith's paper on the Canadian Pacific railway described the construction of the same, and pointed out its advantages. British Columbia joined the confederation in 1871 on a pledge that such a railway should be completed by 1881, afterward extended to 1891, seven hundred miles of it to be built by the government. The working season is about five months, and all supplies and men must be brought a great distance. Three gaps, of about four hundred miles each, now remaining, will be completed by next year. No existing railway has been built so quickly: every thing is completed at once, and in the most systematic manner; the longest delay has been one of three hours waiting for material. The road has been run at the rate of three or four miles per day, the maximum day's work being six miles and three-eighths. Different modes of excavating were compared; nine thousand Chinese work on the Pacific end; Italians and Swedes excavate twenty-five cubic yards per man per day, with shovels, etc.; Americans, with scrapers, move sixty to a hundred yards; and an eight to ten horse grading has been tried. The precaution has been taken of raising the embankment to the snow-level. Telegraphic service is established at the same time, which requires an additional corps of a hundred and fifty men. Coal-beds exist at both ends of the line. Crossing the Rocky Mountains requires some grades of a hundred and sixteen feet to the mile; but the pass is three thousand feet lower than those farther south, and the rest of the line has easy grades. A degree of longitude on this line is eight miles shorter than on the Union Pacific, so that the route from England to Japan can be shortened a thousand miles. Reference was made to the proposed railway from the Pacific to Hudson's Bay, which would be eighteen hundred miles shorter, but navigation is good only four months yearly, — a great difficulty also with the Canadian Pacific, unless it seeks a new outlet in Nova Scotia. This paper will appear in the transactions *in extenso*, and will be of great interest in England. Mr. Hannaford remarked that the six and three-eighths miles per day finished road would, however, be received with an incredulous smile.

On Friday eight papers were read on Mechanical engineering, and with true courtesy the visiting American engineers were placed at the head of the list: in marked contrast, however, was the want of tact displayed in the reception of Mr. Hoadley's valuable paper on steam-engineering practice in the United States, which was limited to so short a time as to amount to a virtual non-presentation. It is now in book form, and an abstract of the same may be expected at the Philadelphia meeting of the American association.

Professor Thurston's paper on the theory of the steam-engine was a historical sketch, tracing from the earliest period to the present the progress of the mechanical theory of heat, and the science of thermo-dynamics and its applications, and the completion of the theory by the addition of a theory of avoidable losses. The labors of Rankine and of Clausius were considered as to their influence on the theory of the subject. It was pointed out that Carnot established a number of fundamental principles, and first produced a consistent theory of heat-engines, which was further perfected by Rankine and Clausius. The limitations in applying the thermo-dynamic theory were described, and shown to have been familiar to Watt and to Smeaton, and to have been experimentally examined by Tredgold, Clark, Isherwood, and Hirn, and studied by Cotterill. It was concluded that the history may be divided, as by Hirn, into three periods: 1. Crude theory and incomplete experiment; 2. Perfected thermo-dynamics and systematic experiment; 3. Complete theory and exact experiment directed toward the determination of wastes. Professor Thurston calls the last two periods those of the theory of the ideal and of the real steam-engine, and believes that a working theory of heat-engines will soon be completely constructed. The complete paper will soon be published. In the discussion it was agreed on all sides, that the thing needed to still further accord theory and practice is an experimental engine specially adapted to scientific investigation; and it is to be hoped that some of our American schools will take hold of the matter before it is done elsewhere. Experiments were also referred to, where a copious supply of oil had reduced cylinder condensation in a marked degree.

Mr. E. D. Leavitt, jun., read a paper on pumping-machinery in America, largely statistical in its nature, in which he briefly sketched the most salient features in the development of the pumping-engine in the United States as applied to water-supply for cities and for mining purposes, giving particulars of the pumping-plant in all the principal water-works in North America. He called attention to the important work done in the development of pumping-machinery by the various hydraulic engineers of this country. Attention was called to those recent improvements in pumping-plant which have brought about the present great economy in certain places, most notably those designed by Mr. George H. Corliss, and others by himself. Prominent among these improvements have been compounding, higher steam pressures, and greater ratios of expansion. In conclusion, he drew attention to considerations from an economic standpoint, which decide whether to use a cheap plant with no great economy of fuel, or an expensive one from which great economy may be expected; the deciding point being, whether the extra cost of fuel for the cheaper plant will exceed the

interest on the extra money invested in the more expensive one.

Mr. J. D. Barnett's paper, on the anthracite-burning locomotive of America, showed that the cleanliness of this fuel was forcing it into use, notwithstanding that it requires a much larger grate-surface, and has an evaporating efficiency but three-quarters that of bituminous coal at market prices: however, where the railroad-companies own the mines, the market price is no basis for comparison. The anthracite is also heavier to carry, and burns the fire-boxes out twenty to forty per cent sooner.

Messrs. A. McDonnell and J. A. F. Aspinwall, and W. Stroudley contributed representative papers on English locomotives. The weights of locomotives were given as from twenty-eight to thirty-nine tons,—much less than our own, but capable of great speed, which, however, is now equalled or excelled here. Improvements are rapidly forcing their way into English engines, which are now built in a limited number of classes, with interchangeable parts. Special tools are not used, however, to any extent in their construction, and but little attention is paid to elegance, or to the comfort of the engineer. Inside cylinders are mostly used; and on one road the driving-wheels are in front, on the supposition that they keep the track better.

Mr. D. Joy furnished a paper on his reversing and expansion valve gear. This is an arrangement of levers, etc., by which the valve motion is obtained from the connecting-rod instead of from the shaft. It is advantageously used on many locomotives, and has been applied also to marine engines. It makes the connections much shorter and lighter, and avoids the double eccentric. Many other advantages are also shown.

Mr. J. H. Bartlett's paper on heating buildings by steam from a central source is a most valuable *résumé* of the subject in pamphlet form. It shows, that, prior to 1876, large buildings and even blocks had been heated by steam from a central source; and in many cases steam had been successfully piped long distances. Mr. Holly then suggested the present district plan; and experiments were made which have led to a remarkable development of the system, which were described in detail. Drawings were given of Holly's reducing-valve and regulator, and of his steam-meter; also a plan of the large district in operation in New York city. Estimates for a district of four hundred (also a thousand) dwellings, and two miles of main, during two hundred and forty days, were given; and the relative cost given of the individual-furnace, individual-steam, and district systems,—the latter with four hundred, also a thousand consumers,—was \$113, \$197, \$64, \$58. The economy of elevating the burning of coal into a distinct business must be evident to all; and there is no better distributer of heat than steam. To form an idea of the magnitude of the New York company's operations, their plant should be inspected.

On Monday, papers were read by Mr. W. Smith, on the light-house system of Canada; and by Sir J. Douglass, on improvements in coast-signals. These were remarkably well illustrated by nearly one thousand square feet of colored drawings, covering the walls, and referring mainly to the new Eddystone light-house. Among these were Winstanley's (1696-1703, washed away), Rudyerd's (1706-1755, burned), Smeaton's (1755-1882, removed to another site),—all of about the same height; and the new light-house nearly twice the height (one hundred and thirty-three feet to lantern). Another drawing reproduced Smeaton's drawing of his light-house with a wave rising fifty feet above it, and added another immense wave which broke over the lantern in 1881, through which the moon was seen. Canada has nearly six thousand miles of coast, with about five hundred light-stations; and Mr. Smith referred to buoys to be placed below Quebec, with reservoirs of gas capable of maintaining a light for ninety hours. He remarked also, that Canada was doing her best to compete with New York for the carrying trade of the west, by improving her light-house system. Experiments are being made by the British government on coast-signals, some results of which were given. The electric light was found to have almost no fog-penetrating power, so that only by an immense multiplication of candle-power was it made equal to gas or oil in the worst weather. Its cheapness showed forcibly, however, in a statement that 22,000 times the light could now be had for the cost of the candles of Winstanley's house. A heavy wave was instanced as carrying away a three-hundred-pound bell, a hundred and ten feet above high water. There would seem, however, to be no reason why, with a properly shaped rock to deflect it upward, a wave might not rise to an immense height. A new system of lights and fog-signals was explained by Sir James Douglass, in which signals are repeated every thirty seconds (instead of three to four minutes); this is more consistent with the present speed of vessels,—though, as Sir William Thomson insisted, much too long a time: a signal should be capable of almost instant recognition. Only red and white lights are used in these 'flashing' signals, and red but sparingly; the signals themselves occupying about ten seconds, and being, in fact, the Morse alphabet with long and short flashes. The French and English governments are doing away with stationary and revolving lights, and introducing flashing ones. Fog-horns with reeds do not stay in order; and a steam siren is to be used, high and low notes being proposed instead of long and short blasts.

Mr. W. H. Preece read three electrical papers,—The 'watt' and the horse-power; Secondary batteries; Domestic electric lighting. Secondary batteries are now an accomplished commercial fact in England, the old Faure accumulator being as good a form as any. Domestic electric lighting can now almost compete with gas, which costs in London three shillings per thousand.

Attention was called to the fact that there is no incandescent lighting in Canada; and Sir W. Thomson called attention to the water-power running to waste in the Lachine rapids. A photographic gallery in Regent Street, London, was referred to, where the electric light is used for the negative and for print-

ing, the pictures being delivered the same night. The dynamo is run by a gas-engine; and it was stated that more light could be thus had from gas, than by burning it directly. Sixteen feet of gas per hour will develop one horse-power.

Dr. W. A. Traill had a paper on the Portrush and Giant's Causeway electric tramway; and Mr. H. Smith, one on electric tramways. The former was accompanied by a working model. A review of previously constructed roads was given, and the points of difference emphasized; and the commercial success of the road was announced. Owing to the interest created by this paper, and the first two, Professor Thompson's paper on dynamo-electric machines was left over.

Mr. C. J. H. Woodbury described the 'automatic sprinkler' system in an American mill, and referred to a slow-burning construction of the latter, where heavy beams, widely separated, support a three-inch planking, on which is laid the flooring of hard wood. A large number of sprinklers have been critically compared in the interest of the insurance companies; and the result of this work showed a record favorable to the value of the apparatus, as it had operated in one hundred and forty-one mill fires, without any instance of total failure except in two instances, where the water supply had been shut off from the system. The sprinklers were tested for sensitiveness by exposing them to a jet of steam instead of a fire, because the former is more regular in its action. The resistance of the soldered joints to shearing-stress was exceedingly variable, ranging from twenty-five hundred to seven thousand pounds per square inch.

The first attempts to make sprinklers were devoted to endeavors to construct an arrangement for rigidly holding a valve to a seat; and, after these had proven failures, the method of soldering a cap over the sprinkler was next introduced. Later, Mr. F. Grinnell solved the problem, by placing the valve in the centre of a flexible diaphragm; and the arrangement of the parts was such that the water-pressure kept the valve shut until the soldered joint leaked, and then this same pressure forced the sprinkler open.

Professor Osborne Reynolds discussed the 'friction of journals.' The report of a committee on lubrication was referred to, and various methods of lubrication discussed. The method giving the best results is to let part of the shaft run in a bath of oil, which is then sucked in by the action of the shaft. With oil fed by a siphon or a plain hole, the friction is seven or eight times greater; and, in one experiment, the oil was forced out of the hole with over two hundred pounds pressure on a square inch. Professor Thurston was called upon, and gave his experience with lubricants, confirming the statements of the paper, and referring to a case in which he had used a pump to force oil to the journals. Evidently, if so much friction can be saved by copious and regular oiling, it might pay to supply journals systematically with oil under pressure.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF MATHEMATICS AND ASTRONOMY.

THE first paper read in this section was by Prof. E. C. Pickering, upon the colors of the stars. The need of exact photometric measurement of different parts of their spectra was first pointed out, and the author then described a very ingenious method of accomplishing this. In the telescope tube, a little beyond the focal plane, is a direct vision prism, so set as to give a spectrum extended in declination; and on the preceding side of this prism is placed a piece of plane glass, whose edges are so ground, that, when a small portion of the following side of the cone of rays falls upon it, it gives a small white ghost, just preceding the spectrum and always opposite the same wave-length. In the focal plane is one of Professor Pritchard's neutral-tint wedge photometers, and behind it a thin metal diaphragm with four long narrow slits parallel to the equatorial motion; so that, when the spectrum transits behind them, four little stars — a red, yellow, blue, and a violet — shine through these slits, and the time of the disappearance of each, as they move towards the thicker edge of the wedge, measures its brightness. From these times may be deduced the magnitude and color curve of the star. To fix the same wave-lengths for each observation, the little white ghost is adjusted upon one of two parallel wires, which project out beyond the preceding side of the diaphragm. For a succeeding transit, the ghost is adjusted upon the other wire, half a slit-interval distant, and thus eight points of the spectrum are photometrically measured. Professor Young, of Princeton, spoke very highly of the ingenuity and effectiveness of the device, especially for the systematic measurement of a large number of stars. He pointed out, however, what might be a source of error; viz., the different sensitiveness of different observers' eyes to different colors, so that they would probably observe the times of disappearance of the four colored stars relatively slightly different.

The next paper, by Professor Daniel Kirkwood, discussed the question whether the so-called 'temporary stars' may be variables of long period, referring to the sometimes-claimed identity of the temporary stars of 945 and 1264 with the well-known Tycho Brahe's star, which blazed forth in Cassiopeia in 1572, and whose position is pretty closely known from his measures. The conclusion reached was, that on account of the sudden apparition of the temporary stars, the short duration of their brightness, and the extraordinary length of their supposed periods, they should be considered as distinct from variables.

Professor Mansfield Merriman, the author of the well-known treatise on 'Least squares,' proposed a criterion for the rejection of doubtful observations, founded upon Hagen's demonstration of the law of frequency of error, which was simpler than Pierce's or Chauvenet's. It involves, however, a determination of what is the unit of increment between errors of different sizes, a thing difficult to determine in very many cases. Professor Harkness, of the Naval observatory, thought that in the case of a criterion for the rejection of doubtful observations, — upon which the most eminent mathematicians disagreed, — practically every one was a law unto himself. He noted the rather doubtful method of taking a large number of shots on a target-board as a good illustration of the law of frequency of error, especially in any such case as that of long-distance shooting, where, on account of the varying character of the wind, the skilful marksman will frequently change his rifle-sights an amount corresponding to twenty or thirty feet on the target, and yet make a complete series of bull's-eyes, or very close to it. Professor Rogers, of the Harvard college observatory, expressed his disbelief in the efficacy of least squares to tell the truth, illustrating it by several cases. For rejecting discordant observations, he referred to the late Professor Winlock's method of determining the personal habit and accuracy of each observer as a means of getting an empirical criterion. He closed with an expression of the opinion that the method of least squares was a method of 'covering a multitude of sins.' Professor Pickering said that we must have some criterion, and every one would practically use one of some kind. He referred to his plan of using 'average deviation' as easier to compute than 'probable error,' and considered five times the average deviation a good limit for the rejection of discordant results. Professor Stone, of the University of Virginia, referred to the very common case of only three, four, or five observations of a star, where the data are not sufficient to apply any criterion, and to the advisability, when it was possible, of making more observations to settle the question. Another speaker referred to the importance of a special search for systematic abnormal errors. Professor Rogers referred to the uncertainty of trusting to the impressions upon one's senses, and said that in nine cases out of ten, where he thought he had observed a transit over a particular wire too early or too late, it would come out just the other way. Professor Hough, director of the Dearborn observatory, thought an observer generally incapable of judging or weighting his observations according to his impressions. In the case of uncertain conditions, like an unsteady atmosphere, he thought it best to quit work and wait for better. Professor Frisby, of the Naval observatory, emphasized the danger of rejecting observations, or forming any arbitrary limit for this purpose. Professor Langley, director of the Allegheny observatory, hoped that further experience would be given upon this question of trusting one's own impressions in rejecting or weighting observations, as it was an exceedingly interesting and important one. Professor Merriman, the author of the paper, referred to the importance of eliminating all sources of systematic errors so far as possible, and of separation into groups, for separate discussion, in order to discover such errors. Professor Rogers referred to the various values of the solar parallax which had been deduced in one way or another by least squares, and another speaker referred to the hidden sources of error which least squares could not deal with. Professor Paul, assistant astronomer at the Naval observatory, said the method of least squares was hardly receiving fair treatment in the discussion, and thought the difficulty was that half or three-quarters of those who used the method failed to bear in mind the theory on which it rested: that it only applied to purely accidental errors; whereas in more than half the cases it is actually applied to errors distributed round a point which is continually moving or jumping, due to systematic sources of error or sudden disturbance, and that no attempt is made to discover and eliminate these systematic or sudden-jumping errors, but least squares is applied indiscriminately to the whole, with a sort of blind faith that it will bring good results out of poor observations, and make it all right somehow. He said that, intelligently applied, the method not only gave the most probable result, but furnished the only measure of the exactness of the observations so far as accidental errors were concerned, and at the same time the most effective method of discovering these hidden sources of systematic error. Professor Stone illustrated this by the case of combining many series of comet-observations, made at different observatories, into one orbit, without attempting to discover any systematic errors in the series of the different observers. The discussion was closed by Professor Eddy with remarks upon the necessity of some criterion dependent upon the results themselves, and independent of the observer's arbitrary judgment.

Professor Pickering then read another paper upon systematic errors in stellar magnitudes, showing, without any question, that the magnitudes of all the star-catalogues from that of Ptolemy down to the great work of Argelander in the Durchmusterung — all depending upon eye estimates — are systematically affected by being in, or close to, the Milky Way; they all being estimated too faint, and the error amounting to about half a magnitude in the Milky Way itself. This arises from the brightness of the background upon which the star is viewed. In the Harvard photometry measures, this source of error is avoided; since, in the comparison of each star with the pole-star, the two fields are superposed, and their added brightness affects both stars alike.

Prof. M. W. Harrington, director of the Ann Arbor observatory, read a paper upon the asteroid ring. He showed that the representative average orbit would be an ellipse of small eccentricity, with semi-major axis equal to about 2.7 times that of the earth, and inclined to the plane of the ecliptic about 1°; and that, in the progressive discovery of these small bodies, the average mean distance had gradually increased, but now seemed to have reached its limit. On the assumption that the surfaces of all the aster-

oids have the same reflecting power as Vesta, Professor Harrington reaches the conclusion that the volume of Vesta is about $\frac{1}{11}$ that of all these 230 bodies put together, and that Vesta and Ceres together form almost one-half the total volume.

Professor Rogers of the Harvard college observatory then read two papers. The first one, upon the magnitude of the errors which may be introduced in the reduction of an observed system of stellar co-ordinates to an assumed normal system by graphic methods, showed a great amount of laborious research, and was a good illustration of the vast amount of monotonous work necessary in the present stage of astronomical observation in order to reach the highest degree of accuracy attainable by the search for and elimination of minute systematic errors. His next paper was upon the original graduation of the Harvard college meridian circle *in situ*. This described a method of turning a meridian circle through any desired constant arc up to about 30° without any dependence upon the circle and reading microscopes, effected by means of an arm swinging between fixed stops, and clamping to a circular ring on the axis by an electro-magnetic clamp. With this Professor Rogers claimed to be able to set off a constant arc through as many as five thousand successive movements of the clamping arm. The ingenious method suggested and carried out by Mr. George B. Clark, of the firm of Alvan Clark & Sons, of grinding the clamping circle to a perfect circular form while the telescope was swung round in its Y's, was fully described, and also Professor Rogers's method of arresting the momentum of the telescope at the stops by water-buffer plungers. The great advantage of thus being able to set off a constant arc independent of the circle and microscopes was pointed out, with especial reference to the investigation of division errors and flexure of circle, and also to the division of the circle itself *in situ*; i.e., mounted on its axis and turning on its pivots. Professor Young called attention to the necessity of guarding against expansion and contraction of the bar holding the stops, due to radiation from the observer's body.

Mr. S. C. Chandler, jun., of the Harvard college observatory, gave the results of observations and experiments with an 'almucantar' of four inches aperture, a new instrument devised by Mr. Chandler, which seems to be of remarkable accuracy, and promises to furnish an entirely new and independent method of attacking some of the most important problems in exact observational astronomy. The instrument consists of a telescope and vertical setting-circle, which can be clamped at any zenith-distance, and is supported on a rectangular base which floats in a rectangular trough of mercury, the whole turning round a vertical axis so as to observe in any azimuth; these observations being simply the times of transit of any heavenly body over a system of horizontal wires in the field. The observations thus far have been entirely upon stars, and all at the apparent zenith-distance of the pole. After some very small periodic variations in the zenith-distance pointing had been traced to changes of temperature, and had been removed by sawing through the wooden bottom of the mercury trough, the instrument showed an astonishing constancy in this zenith-distance pointing, extending over weeks at a time, and far exceeding the constancy of the corrections to the best fundamental instruments of our observatories.

A paper was read by Mr. Chandler, upon the colors of variable stars. Showing, first, that most of the variables were *red*, he described some fairly satisfactory methods which he had used to measure the *degree* of redness of all the periodic variables; and then, plotting a series of points whose abscissae represented the *length* of the periods, and ordinates the *degree of redness*, their agreement with a curve making a very decided angle with the axis of abscissae brought out without question the remarkable law, that, *the redder the star, the longer is its period of variability*. In discussing any theory of variable stars, Mr. Chandler pointed out that Zöllner was the only one who had thus far taken into account two laws already known: viz., 1° that they are generally *red;* 2° that they *increase* in brightness *much more rapidly* than they *decrease;* and now, in any further theory, this new third law must have a place, viz., that, the *redder* they are, the *longer* is their period.

Monday's session opened with a paper by Dr. R. S. Ball, astronomer royal of Ireland, upon the ruled cubic surface known as the cylindroid, whose equation is

$$z\,(x^2 + y^2) - 2\,m\,x\,y = 0.$$

Mr. W. S. Auchincloss of Philadelphia exhibited a balancing-machine for finding the centre of gravity of any number of different weights distributed along a line, which seemed to be of excellent construction, extremely easy and rapid in manipulation, and quite sensitive. In connection with a time-scale of three hundred and sixty-five days at one side, it was shown how rapidly a complicated system of business accounts could be settled, and how it could be applied to various engineering problems.

The next paper was by Prof. J. H. Gore, of the U. S. geological survey, upon the geodetic work of the U. S. coast and geodetic survey. This was a long paper, much of it devoted to a historical *résumé* of geodetic work in all countries. The points of principal interest brought out were the great advantages possessed by the United States in its vast extent of territory, for determining the figure of the earth; and the work already done along the coasts, and along a chain of triangles from the Atlantic to the Pacific, was shown on a map. The great accuracy attained, especially in base-measurement, was noted, and the great improvements made in apparatus and instruments of the survey. Especially was the importance insisted on of a scientific body like the American association supporting in every way the integrity and unity of this great work. In answer to questions, Professor Gore stated that the most recent improvements in the base-measuring apparatus were the determination of the coefficients of expansion for every degree of temperature to which they would be exposed; and he expressed his belief that results

more accurate still would be attained by immersing them in melting ice, so as to keep them at a constant temperature when in actual use.

The next paper was by Mr. J. N. Stockwell of Cleveland, upon an analysis of the formula for the moon's latitude as affected by the figure of the earth. In this Mr. Stockwell claimed that Laplace's formula for expressing this was wrong; the question turning upon an approximate integration of a differential equation, which he claimed to show was wrong by separating into two terms a single one which expressed the difference of two effects, which, thus evaluated separately, became either indeterminate or of an impossible amount.

Prof. J. C. Adams of Cambridge, England, made some comments upon Mr. Stockwell's paper, the audience eagerly crowding forward that they might lose none of the interesting discussion. Professor Adams spoke in high terms of the general work which Mr. Stockwell had done in the difficult subject of the lunar theory; but, from such conclusions and methods as those brought forward in this particular case, he said he must express his total dissent. He then, in the simple yet forcible manner of a master of mathematical analysis, pointed out that this equation was, to begin with, only an approximation; that, before it could be treated at all as a rigorous one, many other small terms must be included; that, further, its integration was only an approximation; and that in this case, any separation into terms, which, on a certain approximate assumption, became either indeterminate or very large, was of no value as a test of the equation; that, in the case of osculating elements referred to by Mr. Stockwell, these in no sense represented an average orbit, but only an instantaneous state of ever-varying elements; and that any integration proceeding on the first hypothesis, over a long period, would introduce an error increasing with the time which would swallow up entirely the perturbations sought. The celebrated astronomer, than whom neither England nor the whole continent of Europe could have sent one more competent to advise, then closed with a few remarks pregnant with suggestion to workers in the lunar theory, upon the general methods to be followed in these long and difficult solutions by *approximations*. Hearty applause followed; and the animated discussion was brought to a good-natured close, Mr. Stockwell still unconvinced, hoping that when Professor Adams had given more attention to this particular point, he would come to think the same of it as himself; and Professor Adams (amid much laughter) hoping that day would never come.

In Tuesday's session, Professor Ormond Stone, director of the Leander McCormick observatory of the University of Virginia, gave an elaborate description of that observatory now approaching completion, and to be devoted entirely to original research. The telescope, which will soon be mounted, is the twin in size of the Washington twenty-six inch, and like it in most of its details, except the driving-clock, which is like that of the Princeton twenty-three inch, with an auxiliary control by an outside clock, and that it has Burnham's micrometer illumination. The observatory has a permanent fund of seventy-six thousand dollars as a beginning; and eighteen thousand dollars have been expended in observatory buildings, and eight thousand dollars for the house of the director. Situated eight hundred and fifty feet above the sea, and on a hill three hundred feet above surroundings, the main building, circular in shape, is surmounted by a hemispherical dome forty-five feet in diameter. The brick walls have a hollow air-space, with inward ventilation at bottom and outward at top. Mr. Warner, the builder of the dome, gave an interesting description of the ingenious method of adjusting the conical surfaces of the bearing-wheels, so that they would, without guidance, follow the exact circumference of the tracks; and then of the adjustment of the guide-wheels, so that the axis of this cone should be exactly normal to the circular track. The framework of the dome consists of thirty-six light steel girders, the two central parallel ones allowing an opening six feet wide. The covering is of galvanized iron, each piece fitted *in situ*, and the strength of the frame is designed to stand a wind-pressure of a hundred pounds per square foot. There are three equal openings with independent shutters, the first extending to the horizon, the second beyond the zenith, and the third so far that its centre is opposite the division between the first and second. The shutters are in double-halves, opening on horizontal tracks, and connected by endless chain with compulsory parallel motion of the ends. The dome weighs twelve tons and a half, and the live-ring one ton and a half; and a tangential pressure of about forty pounds, or eight pounds on the endless rope, suffices to start it. If this ease of motion continues as the dome grows old, it is certainly a remarkable piece of engineering work.

In the discussion which followed, Professor Hough said that he should prefer the old style of single opening extending beyond the zenith. Professor Stone could not agree with him, the greater extent of opening making it less probable that the dome would have to be moved so far in turning from star to star, and at the same time furnishing better ventilation, and the opportunity for cross-bracing adding strength to the dome. He stated that he should first take up the re-measurement of all the double stars of less than 2″ distance between 0° and −30°.

Father Perry, the director of the observatory at Stonyhurst, Eng., gave the result of late researches on the solar surface, with special reference to evanescent spots. No abstract can give any idea of the wide range of interesting topics covered in this paper. The multitude of ever-changing details to be observed on the sun, and the careful record of these which is kept at the Stonyhurst observatory, furnished the material for a paper replete throughout with new and important details, to which nothing but a publication in full can do any justice whatever; and it is to be hoped that the association will soon give the public the opportunity to read it in this way.

On Wednesday, Mr. Lewis Swift, director of the Warner observatory at Rochester, N.Y., read a paper upon the nebulae, in which he described his method

of search for new nebulae, and of simply recording their approximate positions by pointing with unilluminated cross-wires in the eye-piece, and reading off the circles of the instrument, recording with this a description of the appearance of the nebula. His reason for making no attempt to determine accurate positions was that it would require illuminated micrometer-wires, and a great deal of time devoted to measurement with neighboring stars, besides much time lost in letting the eye become sensitive again for further search or examination after the light was removed; he stating that his eye was practically 'nebula blind' for at least four minutes after being near a light. Since, however, the most of these nebulae are probably too faint to bear any illumination at all, and must therefore be observed for position with ring or bar-micrometer, much of this reason loses its force; for in this case there would be no loss of time on account of light, and if in this way Mr. Swift could connect each of these new nebulae to some neighboring star with the help of chronograph or an assistant at clock or chronometer, and also re-observe the known nebulae in the same way, the value of the work would be almost immeasurably increased compared with the little additional time and labor necessary for its accomplishment. As it is, though no one will deny the value of a catalogue of even the approximate positions and descriptions of very faint nebulae, as a contribution to our knowledge of their number and distribution, and as an aid in comet-seeking or identification, yet it is fairly open to the criticism, that, to be what it should be in the present state of astronomical observation, it must all be gone over again for determinations of accurate positions. One very interesting statement of Mr. Swift, to the effect that there had not been a first-rate clear sky since the red glows appeared a year ago following the Krakatoa explosions, bears out the general experience of workers in other observatories, especially those who try to see stars near the sun in the daytime.

An interesting discussion arose as to the much-disputed existence of the nebula round the star Merope in the Pleiades; the general drift of it being that the nebula no doubt existed, but in order to see it a clear sky was necessary, and a very low power and large field, so that the nebula might be contrasted with darker portions of the same field; that a large telescope was not necessary, in fact the smaller the better, provided the optical qualities were relatively as good. Mr. Swift said he could always see it under favorable conditions; and Mr. E. E. Barnard of Nashville, Tenn., the discoverer of the latest comet, said that before he knew of its existence at all, he picked it up as a supposed comet.

On Thursday Professor Adams of Cambridge, Eng., read a paper upon the general expression for the value of the obliquity of the ecliptic at any given time, taking into account terms of the second order. The difficulties of obtaining a formula for this quantity, on account of the many varying elements upon which it depends, were clearly explained by a diagram, and the results given of an approximation carried much further than ever attempted heretofore.

Professor Harkness, in paying a high compliment to the celebrated mathematician and astronomer for these laborious and valuable researches, also expressed a wish that some of the n-dimensional-space mathematicians would follow the example of Professor Adams, and apply some of their superfluous energy to the unsolved problems in the solar system, which have some direct practical bearing.

Professor Newcomb, in remarking upon the mass of the moon used in this problem, expressed the opinion that this could be obtained most accurately by observations of the sun, in determining the angular value of the radius of the small circle described by the earth about the common centre of gravity of earth and moon, since this, in his opinion, seemed to be the only constant which could be determined by observation absolutely free from systematic errors, and hence was capable of an indefinite degree of accuracy by accumulated observations; and he asked Professor Adams's opinion on this point.

The latter replied, that he thought the quantity too small for *certain* accurate determination, almost beyond what could be actually seen by the eye in the instruments used.

Professor Newcomb admitted, in the case of *absolute* determinations, the general impossibility of attempting to measure what cannot be seen; but, in the case of *differential* or *relative* determinations in which there was no supposed possibility of constant or systematic errors, he advanced the theory, which he had thought of elaborating more fully at some time, that such determinations might be carried by accumulated observations to a sure degree of accuracy far beyond what can be seen or measured by the eye absolutely.

Professor Adams hoped he would more fully elaborate and publish this idea, since there was in it an element well worth careful consideration.

Professor Harkness doubted the sufficient accuracy of meridian observations of the sun, on account of the distortions produced by letting the sun shine full into the instrument; and spoke of the difficulties in the transit-of-Venus observations from this cause.

Professor Newcomb replied that he would have to show that this would be periodic with reference to the moon's quarters in order to affect this constant systematically.

Professor Adams then presented another note upon Newton's theory of atmospheric refraction, and on his method of finding the motion of the moon's apogee. He described in an exceedingly interesting manner how some unpublished manuscripts of the great geometer had lately come into his hands at Cambridge, which contained later work than is published in the Principia. Space will not allow a description of the methods which these papers show that Newton employed in attacking, and remarkably successfully too, some of the problems which still trouble astronomers to-day. Photographs of these papers were exhibited, showing his wonderful neatness and precise methods in [illegible]
something of a novelty to thos[illegible]
occasion, to hold in their hands [illegible]

handwriting and computations of this intellectual giant, whose works will for all time be the greatest wonder to him who studies them the most.

With the hearty thanks of the section to Professor Adams for his exceedingly interesting communications, it was then adjourned.

PROCEEDINGS OF THE SECTION OF PHYSICS.

THE meeting of the American association was one of unusual interest and importance to the members of section B. This is to be attributed not only to the unusually large attendance of American physicists, but also to the presence of a number of distinguished members of the British association, who have contributed to the success of the meetings not only by presenting papers, but by entering freely into the discussions. In particular the section was fortunate in having the presence of Sir William Thomson, to whom more than to any one else we owe the successful operation of the great ocean cables, and who stands with Helmholtz first among living physicists. Whenever he entered any of the discussions, all were benefited by the clearness and suggestiveness of his remarks.

Among the members of the British association who were present, may also be mentioned Professor Fitzgerald of the University of Dublin, Professor Silvanus P. Thompson, Mr. W. H. Preece, superintendent of the English postal telegraph, Professor Forbes, and Professor Schuster of the Cavendish laboratory.

Among American physicists there were Professors Trowbridge, Rowland, Barker, Mendenhall, Hall, Hastings, Bell, Anthony, Brackett, Rogers, Pickering, Cross, and many others. The section was organized on Thursday, Sept. 4, and the opening address delivered by the vice-president, Professor Trowbridge. The time devoted to the reading and discussion of papers was unfortunately much infringed upon by the Electrical conference: yet, considering this serious interruption, the number of interesting discussions was unusually large.

It is not to be expected that the elaborate investigation of the relation of the yard to the metre, such as was the subject of a paper by Professor William A. Rogers, will be of very general interest. Yet to the physicist such a comparison, conducted by one who has had the long experience of Professor Rogers, is of the highest importance in giving accuracy to determinations of length. Professor Rogers has given his life to perfecting the construction and testing of standards of length, and the result of this his latest investigation is that the metre is 39.37027 inches in length. One of the most important physical measurements is that of the wave-length of light of any given degree of refrangibility, and this determination is best made by means of the diffraction grating. On account of the extensive use of the magnificent gratings constructed by Professor Rowland for this purpose, Professor Rogers instituted an investigation to determine the coefficient of expansion of the speculum-metal used in the construction of these gratings. He also noted that from its homogeneity, fineness of grain, and non-liability to tarnish, this speculum-metal is peculiarly suitable for constructing fine scales, though its extreme brittleness is an objection to its use for large scales. Professor Rowland stated that he proposed to construct scales on his ruling-engine which would enable the physicist at any time, by purely optical means, and without knowing the coefficient of expansion of the metal or its temperature, to obtain the value of the length of the scale in terms of the wave-length of any given ray of light. These scales were simply to be straight pieces of speculum-metal ruled with lines just as an ordinary grating, except that the length of the lines is to be only about one centimetre, every one-hundredth line being somewhat longer than its neighbors: the whole ruled strip is to be one decimetre in length. From the manner of ruling, it will be easy to count the whole number of lines in the length of the strip, and then by a simple use of the scale as a grating in a suitable spectrometer the whole length may be immediately found at any time in terms of any specified wave-length of light.

In some forms of telephones and in the microphone, the action depends on the change in resistance of a small carbon button on being subjected to pressure. There has been much discussion as to whether this diminution of the resistance with pressure is due to a change in the resistance of the carbon itself, or simply to the better contact made between the carbon and the metallic conductor when the pressure is applied. Professor Mendenhall has carried out some experiments to determine the question; and one of his methods of experimenting — that with the hard carbons — appears to point conclusively in favor of the theory that the resistance of the carbon itself is altered by pressure. The experiments made by him on soft carbon are open to criticism, though they also point to the change taking place *in* the carbon. Professor Mendenhall finds that the resistance is not simply proportional to the pressure, and thinks that by increasing the pressure a point of maximum conductivity would be reached where there would be no change in resistance for a small change in pressure.

Prof. A. Graham Bell, the inventor of the telephone, read a paper giving a possible method of communication between ships at sea. The simple experiment that illustrates the method which he proposed is as follows: Take a basin of water, introduce into it, at two widely separated points, the two terminals of a battery-circuit which contains an interrupter, making and breaking the circuit very rapidly. Now at two other points touch the water with the terminals of a circuit containing a telephone. A sound will be heard, except when the two telephone terminals touch the water at points where the potential is the same. In this way the equipotential lines can easily be picked out. Now, to apply this to the case of a ship at sea: Suppose one ship to be provided with a dynamo-machine generating a powerful current, and let one terminal enter the water at the prow of the ship, and the other be carefully insulated, except at its end, and be trailed behind

the ship, making connection with the sea at a considerable distance from the vessel; and suppose the current be rapidly made and broken by an interrupter: then the observer on a second vessel provided with similar terminal conductors to the first, but having a telephone instead of a dynamo, will be able to detect the presence of the other vessel even at a considerable distance; and by suitable modifications the direction of the other vessel may be found. This conception Professor Bell has actually tried on the Potomac River with two small boats, and found that at a mile and a quarter, the farthest distance experimented upon, the sound due to the action of the interrupter in one boat was distinctly audible in the other. The experiment did not succeed quite so well in salt water.

Professor Trowbridge then mentioned a method which he had suggested some years ago for telegraphing across the ocean without a cable; the method having been suggested more for its interest, than with any idea of its ever being put in practice. A conductor is supposed to be laid from Labrador to Patagonia, ending in the ocean at those points, and passing through New York, where a dynamo-machine is supposed to be included in the circuit. In Europe a line is to extend from the north of Scotland to the south of Spain, making connections with the ocean at those points: and in this circuit is to be included a telephone. Then any change in the strength of the current in the American line would produce a corresponding change in current in the European line; and thus signals could be transmitted. Mr. Preece, of the English postal telegraph, then gave an account of how such a system had actually been put into practice in telegraphing between the Isle of Wight and Southampton during a suspension in the action of the regular cable communication. The instruments used were a telephone in one circuit, and in the other about twenty-five Leclanché cells and an interrupter. The sound could then be heard distinctly; and so communication was kept up until the cable was again in working-order. Of the two lines used in this case, one extended from the sea at the end of the island near Hurst castle, through the length of the island, and entered the sea again at Rye; while the line on the mainland ran from Hurst castle, where it was connected with the sea, through Southampton to Portsmouth, where it again entered the sea. The distance between the two terminals at Hurst castle was about one mile, while that between the terminals at Portsmouth and Rye amounted to six miles.

A few years ago Mr. E. H. Hall, then a student at the Johns Hopkins university, taking a thin strip of gold-leaf through which a current of electricity was passing, and joining the two terminals of a very sensitive galvanometer to two points in the gold-leaf, one on one edge, and the other on the other, choosing the points so exactly opposite that there was no current through the galvanometer, found that on placing the poles of a powerful electro-magnet, one above and the other below the strip of gold-leaf, he obtained a current through the galvanometer, thus indicating that there was a change in the electric potential, due to the action of the magnet. Mr. Hall explains this change by supposing the rotation of the equipotential lines in the conductor about the lines of magnetic force. This explanation has been brought into question by Mr. Shelford Bidwell, who attempts to explain the action thus: The magnetic force acting on the conductor carrying the current would cause the conductor to be moved sideways, were it free to move; but, since it is held by clamps at the ends, the magnetic force acting upon it brings it into a state of strain, one edge being compressed and the other stretched; and Mr. Bidwell supposes the whole Hall effect to be due to thermal actions taking place in consequence of this unsymmetrical state of strain. Professor Hall, who is now at Harvard, has made some careful experiments to test this explanation of Mr. Bidwell. He used not only gold-leaf, but strips of steel, tinfoil, and other metals, and clamped them sometimes at both ends, sometimes in the middle, and sometimes only at one end; and in all cases the action was the same, with the same metal, irrespective of the manner of clamping. This was strong evidence against Mr. Bidwell's position. Sir William Thomson suggested, as a further test, to bring about the state of strain, which Mr. Bidwell supposes to be the primary cause of the action, by purely mechanical means, bringing pressure to bear on one side or the other, and seeing whether the action obtained is at all commensurate with the action found by Mr. Hall.

Professor Hall then discussed an experiment by which Mr. Bidwell had obtained a reversal of the effect; and showed that the reversal was only apparent, and that when carefully examined the results of Mr. Bidwell's experiment were best satisfied by the theory of the rotation of the equipotential surfaces about the lines of magnetic force. Sir William Thomson spoke of the discovery of Mr. Hall as being the most important made since the time of Faraday. He favored Mr. Hall's explanation; though he considers Mr. Bidwell's suggestion as very important, and thinks that it will very likely be found that both the Hall effect and thermal effects have a common cause, rather than that one is to be taken to explain the other. He showed also that the mathematical examination of the subject indicates three relations to be investigated, — first, the relation of thermal force to the surfaces of equal rate of variation of temperature; second, the relation of electric current to the equipotential surfaces; third, the relation of the thermal flow to isothermal surfaces. The second of these is that investigated by Mr. Hall, who has found that under the conditions mentioned the lines of flow are *not* perpendicular to the equipotential surfaces. There remains, therefore, 'work for two more Halls,' in either proving or disproving the existence of the analogous actions in these other two cases. Sir William Thomson also suggested the following exceedingly interesting mechanical illustration or analogue of Hall's effect. Let us be living upon a table which rotates uniformly forever. A narrow circular canal is upon this table, concentric with the axis of rotation of the table, and nearly

full of water. After a while the water will acquire the same velocity of rotation as the table, and will come to a state of equilibrium. The outer edge of the water in the canal will then stand a little higher than the inner edge. Let us now apply a little *motive* force to the water, and by means of a pump cause it to flow in the canal in the same direction in which the table is already rotating: it is evident that it will stand higher on the outer edge, and lower on the inner edge of the canal, than before. But, should we cause it to flow in the opposite direction to the motion of the table, it will stand lower on the outer edge, and higher on the inner edge, than in its position of equilibrium.

The experiment made by Mr. Shelford Bidwell may also be illustrated by putting a partition in the canal so as to divide it into two circular concentric troughs, and making a little opening in the partition at some point; then taking two points near the opening in the partition, one in one trough and one in the other, if they are very close to the partition, the point in the outer trough will be at a *lower* level than that in the inner one; but if they are not close to the partition, but one is taken close to the outer edge of the outer trough and the other close to the inner edge of the inner trough, then the point in the outer trough will be at a *higher* level than that in the inner trough, though the difference in level will be only about half of what it would have been had there been no partition separating the canal into two troughs. Professor Forbes called attention to the fact that the classification of the metals according to their thermo-electric qualities gives not only exactly the same division into positive and negative, but that the very *order* obtained in that way corresponds to that obtained by classifying according to the Hall effect, except *possibly* in the case of aluminium.

Prof. Silvanus P. Thompson read a paper on the government of dynamo-machines. It is a subject of considerable importance from the practical point of view, and Professor Thompson has given a great deal of thought to it. After reviewing and criticising the methods used by Marcel Desprez and Ayrton and Perry, he proposed a method devised by himself, and which he has successfully employed. It was what he calls a dynamometric method, since it is based on the employment of a transmitting dynamometer as a governor. In this way the governing action is made proportional to the rate of work. Professor Thompson's very simple device is to have resistance-coils so placed in the pulley of the transmitting dynamometer, which is fixed to the shaft, that as the rate of work varies, and the movable pulley of the dynamometer changes its position with reference to the fixed pulley, resistance will be added to or taken from the circuit; thus modifying the current, and bringing about the required government.

An interesting paper was also read by Professor Wead, in which he gave the results of some experiments made on the energy absorbed by organ-pipes in producing sound. Among other things, he showed that reeds are very much more efficient than pipes, giving far louder sound with less expenditure of energy. He also showed that the results of his experiments, on the energy absorbed by pipes of similar shape but different pitch, confirm the practical rule adopted by organ-builders in increasing the proportional diameter of the pipes as the pitch increases, so as to maintain equal loudness. Professor Wead finds, that for a rise in pitch of sixteen semitones, one-half the energy is required in order to give a scale of sensibly equal loudness.

Professor Loudon read a very interesting paper, giving simple geometrical constructions for determining the cardinal points of a thick lens or a system of thick lenses. It is to be hoped that he may publish his paper in full.

Many other papers were read of more or less interest, but those given are the most important.

NOTES AND NEWS.

It may be well to call attention once more to the course of eighteen lectures by Sir William Thomson, on molecular dynamics, at the Johns Hopkins university in October. Professors and students of physics are invited to attend.

— The following persons were elected officers of the American association for the advancement of science for the ensuing year: President, H. A. Newton of New Haven, Conn.; permanent secretary, F. W. Putnam of Cambridge (office, Salem, Mass.); general secretary, Charles Sedgwick Minot of Boston, Mass.; assistant general secretary, Charles C. Abbott of Trenton, N.J.; treasurer, William Lilly of Mauch Chunk. Section A, mathematics and astronomy, J. M. Van Vleck of Middletown, Conn., vice-president; E. W. Hyde of Cincinnati, O., secretary. Section B, physics, C. F. Brackett of Princeton, N.J., vice-president; A. A. Michelson of Cleveland, O., secretary. Section C, chemistry, W. R. Nichols of Boston, Mass., vice-president; F. P. Dunnington, University of Virginia, Va., secretary. Section D, mechanical science, J. Burkitt Webb of Ithaca, N. Y., vice-president; C. J. H. Woodbury of Boston, secretary. Section E, geology and geography, Edward Orton of Columbus, O., vice-president; H. Carvill Lewis of Germantown, Penn., secretary. Section F, biology, Burt G. Wilder of Ithaca, N.Y., vice-president; M. C. Fernald of Orono, Me., secretary. Section G, histology and microscopy, S. H. Gage of Ithaca, N.Y., vice-president; W. H. Walmsley of Philadelphia, Penn., secretary. Section H, anthropology, W. H. Dall of Washington, D.C., vice-president; Erminnie A. Smith of Jersey City, N.J., secretary. Section I, economic science and statistics, Edward Atkinson of Boston, Mass., vice-president; J. W. Chickering of Washington, D.C., secretary.

— The next meeting of the British association will be held at Aberdeen.

— It was suggested by Capt. Bedford Pim, at Philadelphia, that the 1886 meeting of the American association should be held in London. It is understood that there is no constitutional obstacle in the way of the association meeting outside of America; and it

is possible that through the efforts of Capt. Bedford Pim an invitation may be received from the city of London.

—Dr. Dobell, in writing to the London *Times*, directs attention to a method of destroying cholera and typhoid germs, in drinking-water, by passing through it an electric current, and thereby exposing it to the influence of nascent oxygen, by which means the water would be dezymotized. This suggestion of Dr. Dobell's seems to have been forestalled by the construction of a filter invented by Dr. Stephen H. Emmons, which is now on view at the offices of the Economic electric company in London. The filter consists of an earthenware vessel, in which are placed porous cells containing carbon plates, the spaces between the plates and the cells being partially filled with animal charcoal. The plates are coupled up with the positive pole of a Leclanché battery or of one of the company's own chromozone batteries. Alternating with the porous cells are other carbon plates, which are coupled up with the negative pole of the battery. The water is supplied into the porous cells, and passes through the charcoal to the exterior of the cells, and is drawn off by a tap in the usual way. It is claimed, that by this means, the water being submitted to the influence of the evolved nascent oxygen, as suggested by Dr. Dobell, the *materies morbi* of typhoid, cholera, and similar diseases are destroyed, and that an end is put to the dreaded danger of, 'death in the pot.'

—The 7th of last August was signalized in France by three balloon ascensions. Gaston Tissandier and Georges Masson, the editor and publisher of *La nature*, made an ascent from Paris (a diagram of the course of which we reproduce from that journal), which occupied three hours and twenty minutes. While they were in the air, Shoste crossed for a second time the English channel; starting alone from Boulogne at 7 P. M., and descending at 9.50 P.M. at New Romney. In the evening, Hervé made an ascension at Paris in a balloon provided with some aëronautic apparatus constructed on a new system.

—Among the diamonds reserved from the approaching sale of the crown jewels of France is the Regent, so-called, which is retained on account of its mineralogical rarity, its perfect shape, its limpid

color, great size, and fame. According to *La nature*, from which we take the accompanying illustration representing its exact size, it is the largest brilliant known.

—In lecturing at the Health exhibition, on cholera and its prevention, Mr. de Chaumont expressed his opinion, that, "in regard to disinfectants, there is but one true disinfectant; viz., fire. The majority of so-called disinfectants are simply deodorants. The idea that tobacco-smoke or the odor of camphor is destructive of contagion is still extensively held, though it is simply absurd. A true disinfectant is a substance that will kill the germ or living particle in which the contagious principle resides, or through which it is conveyed."

On the other hand, Mr. de Cyon, at a séance of the Académie des sciences on July 21, recommended as a prophylactic against cholera, boracic acid, or a solution of borax, to be applied to all the external mucous membranes, and about six grains of borax to be taken with the food and drink every twenty-four hours.

—At a meeting of the Association of public sanitary inspectors in London, on Aug. 11, Mr. Edwin Chadwick read a paper on preparations for meeting the cholera, giving his experiences of the action of the board of health in the visitation of 1848–49. It would be in accordance, he thought, with the previous advances of the disease in periodic bounds upon Europe, that it should sooner or later again visit England. The practice of quarantine he considered useless and mischievous. The last decade had shown a reduction of the sickness and death-rate by nearly three-quarters of a million, and a saving of some four millions of money, incontestably from the reduction of the foul-air diseases operated upon by the services of the sanitary inspectors.

— Among the celebrities at the Medical congress at Copenhagen were Virchow, Pasteur, Lister, Volkmann, Esmarch, Spencer Wells. Pasteur's address on the prophylactic inoculation for hydrophobia was the sensation of the congress. In professional circles there are still many sceptics, and Pasteur still hesitates to try his experiments on man. The French committee appointed by Mr. Fallières are watching his experiments in Paris. Pasteur believes in the existence of special microbes of the disease, but has not discovered any as yet. Professor Andeli of Rome spoke on the causes of malaria: the primary cause he considered to be subterranean water, and the subsidence of the top soil. In conjunction with the necessary draining, he recommended as a remedy a careful use of arsenic, with the treatment with quinine. Professor Verneuil of Paris continued the subject on the same lines. At the third sitting, Sir William Gull spoke on the formation of an international institute for the study of diseases; and his resolution was passed, forming the following international committee for the purpose: for Germany, Ewald and Bernhard; France, Bouchard, Levine; Great Britain, William Gull, Humphrey, and Mac Cormac; with Professor Owen as general secretary. On the 15th, Professor Virchow spoke on 'Metaplasia;' and on the 16th the congress closed with Professor Panum's address on 'The food of healthy and unhealthy men.' The next congress will be held at Washington, in 1887. Professor Virchow's closing address was received with immense applause.

— On June 30, in Bremen, a technical commission met to discuss the export of German coal. The question whether a German coal-export company should be formed was answered in the affirmative; but a preliminary committee of inquiry was elected to report on the capabilities of foreign markets, to study their relative positions, and to make representations to the Prussian minister of railways as to tariff regulations and the improvement of loading and unloading arrangements at the harbors.

The August number of the *Kansas City review of science and industry* contains an enthusiastic article on meteorological discoveries, by Isaac P. Noyes of Washington, in which the weather-map is extolled as the basis of progress in meteorology. While many will agree with the writer, that the daily maps of the weather are of great value, it seems that he places too great importance on the 'highs' and 'lows,' as he terms barometric elevations and depressions in accordance with what may be styled signal-service slang; and that he gives too little credit to what was known before the advent of weather-maps. The following quotation illustrates Mr. Noyes's low opinion of earlier studies: "Until we had this wonderful weather-map, we had little or no conception of the meteorological phenomena of the world. For example, the tornado. The old 'physical geography' system had various names for this violent phenomenon, such as *cyclone*, *hurricane*, and *tornado*, and undertook to draw a line between them, giving certain characteristics to one which it did not give to the other. The map reveals the fact that they [are] all one and the same, and that they proceed f[rom] 'low'" (p. 202). But this opinion is certainly [open] to criticism; for if any fact is well proved by weather-maps, it is that tornadoes are essentially [dif]ferent from cyclones, instead of being one and [the] same with them. A somewhat broader and m[ore] careful study of the old system, as well as of [the] newer weather-maps, might again suggest am[end]ments to such assertions as these: "The violent w[ind] storm we call tornado or cyclone when it occurs [will] always be in the track of 'low,' and generally a[t an] acute angle thereto" (p. 202); "The cause of [the] barometer we ascribe to concentrated heat" (p. 1[..]). The confusion of terms and error of statemen[t in] the first of these extracts, and the vagueness of [ex]planation in the second, are especially unfortunat[e in] an article seemingly intended for popular instruct[ion].

— We reproduce from *Science et nature* a pict[ure] of the statue of the Marquis Claude de Jouff[roy], executed by Charles Gautier, erected at Besanç[on], France, and inaugurated last month. De Jouff[roy] was the first to make a serious attempt to apply st[eam] to navigation after Papin's experiments in 1[...]. De Jouffroy's first experiments were made on [the] Seine in 1775, and the Doubs in 1776, and afterw[ards] more successfully on the Saône at Lyons in 1780.

SCIENCE.

FRIDAY, SEPTEMBER 26, 1884.

COMMENT AND CRITICISM.

THE historical method is now applied to the solution of so many questions of every-day life, formerly studied in the light of philosophy, that the formation of an American historical association really marks the opening of a new era in the history of scientific research. Henceforth historical students, like other scientific men, will have an opportunity to make themselves known, without awaiting the tardy recognition of a publisher. It is for the future to show whether the high standard already set up can be maintained; but, assuredly, there is no reason why the meetings of the association should not be the chosen place for the best students to make known the results of their labors.

IN 1872 Professor Asa Gray relinquished to younger hands all instruction in botany in Harvard university, in order that he might give his time to the completion of the 'Flora of North America.' Notwithstanding the many serious encroachments which have been made upon his time by the demands of the herbarium, by the voluminous contributions to the proceedings of the American academy, by his editorial work in connection with the *American journal of science*, by the revision of his text-book, and by his very extensive correspondence, he has carried a second volume of his great treatise through the press. It seems proper for us, in connection with the review of this volume in another part of this number, to remind our readers of the forcible and yet pathetic appeal which Professor Gray has more than once made in behalf of an exemption for himself and Mr. Sereno Watson from the time-consuming task of answering notes of inquiry respecting the more common plants of our flora. Thanks to botanical activity at various places throughout the country, beginners can have their questions well answered by local societies, while more advanced students can now easily confer together in regard to the more difficult points. By such sifting as this would bring about, the number of questions which should properly be referred to the herbarium would be surprisingly diminished. It must seem plain to every one of our readers, upon reflection, that it cannot be discourteous, in the officers of our larger collections which are now being utilized in the preparation of works of reference, to quietly ignore those letters which ought never to reach them.

WE owe our readers a word of explanation, which we make this week, *apropos* of the long letter of reclamation on another page. It is the aim of *Science* to express just and impartial criticisms whenever they are called for, and it is our intention to continue the pursuit of this aim. We regret extremely if any one believes that we are animated by any unjust prejudices against American work; but it is evidently our duty to be, if any thing, more outspoken in regard to American than to foreign scientific labor. In writing of our own country, we do not wish to let false pride substitute laudation for justice, neither do we wish to praise any thing merely because it is from abroad. It is a heavy accusation which our correspondent makes against us, and we hope our readers will acquit us. Dr. Salmon's assertion that American work on Microbia includes some of the best researches on the subject does not coincide with the opinion of competent and uninterested judges. We must therefore still adhere to the judgment we have expressed as to the relative value of American contributions to the knowledge of micro-organisms. If Dr. Salmon's own work is recognized hereafter to have the value which he assigns to it, we shall be very happy to acknowledge the

change of opinion on the part of those in whose decisions on the matter we have full confidence.

It is quite impossible for congress, when it grants an immunity to colleges in the importation of printed matter duty-free, to set forth in detail the administrative processes which are necessary to secure its purpose. Congress acts on the assumption that the executive departments of government have wisdom enough in so ordering details, that the purpose of congress shall be adhered to, and that education shall have the advantages the people, through them, have decreed. Everybody but an executive routinist, whose perceptions are dwarfed by his habit, sees a higher claim in the spirit than in the letter of a law. It weré a libel on barbarism to stigmatize as barbaric the recent decision of the treasury, which requires twelve oaths a year and attendant time and money for a monthly periodical to secure a free entry. Let us commend to the astute revenue-officials the story of Poor Richard and the barrel of salt beef, when a single grace over the whole could save for twelve-months' dinners a considerable fraction of the time allotted to the poor dwellers of the globe. Further let them remember graces at dinner do not cost notary's and justice's fees.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The Ohio earthquake.

A slight earthquake was felt here at 2 h. 43 m. this afternoon. Hanging lamps were made to vibrate, and at one of the public-school buildings a panic occurred among the children. The shock was not noticed by those who were busily employed at the time. No attempt was made to measure its direction or force.

E. T. Nelson.

Delaware, Ohio, Sept. 19.

The steep slopes of the western loess.

In Mr. Macfarlane's paper on the formation of cañons and precipices (*Science* for Aug. 1), there is a discussion of the cause of the steepness and permanence of the slopes in the loess region of the west. The fact is certainly a striking one. But Mr. Macfarlane's explanation, likening it to 'a well-built piece of miniature natural earth masonry well bound together,' scarcely does justice to the subject. For, in the first place, the steep slopes recur in the typical loess, *even after it has been moved and worked over*; especially after it has lain for a few years, so that a slight 'binding-together' of the particles by calcic carbonate is renewed. In the second place, the form of the loess particles is, as a rule, not flattened, but roundish; as can readily be seen, when the sediments from a mechanical analysis of the material are examined. But this general roundness of the particles is accompanied by an extreme roughness of surface, precisely such as is seen on the large scale in the 'loess puppets' themselves. The entire mass, in fact, consists of small calcareous secretions, with rough concretionary surface, intermingled with a comparatively small proportion of fine dust and clay (see *Amer. journ. sc.*, n. s., vii. 10); and, when treated with dilute acid, the whole frequently becomes altogether impalpable. These rough concretionary sand-grains naturally can move only with great friction in the mass; and the latter being, moreover, very porous, absorbing instantly even a copious shower, there is little opportunity for washing away. Aside from these purely physical causes, the rapid formation of a tissue of cryptogamic fibrils and gummy matter (mostly moss prothallia) on the fertile material, soon binds the surface, and imparts additional stability.

E. W. Hilgard.

Berkeley, Cal., Aug. 20.

An open polar sea.

In an article in the New-York *Herald* of Sept. 10, Joseph W. Cremin, A.M., comments upon some remarks made by me before the British association at Montreal, in regard to the theory of an open polar sea. Mr. Cremin agrees with Lieut. Greely in the belief that there is such a sea, but fails to put forward any facts in support of his theory. And in view of the fact that so far we have found nothing but ice along the southern border of this unknown region, it is fair to presume that the ice-cap extends over the pole, unless facts can be brought forward to prove to the contrary.

Now, the facts that have convinced me that there is no permanent open water are these: 1°. Migratory birds do not pass into this region beyond the highest known land; and there is a decrease of animal life as you go north, both in the sea and on the land. Also the annual mean temperature falls as you approach the pole. 2°. The ancient ice which is being constantly displaced by the new ice that forms in the cracks opened by tides and gales is constantly coming down from the higher latitudes. If there were an open sea to the north, would this be the case? It naturally yields toward the side of the least resistance. 3°. The water in the Arctic Ocean stands at a temperature of +29° F. from October until June, with a range of less than .3 of 1°. Off the northern coast of North America, the currents are variable; and if there were an open sea, which must necessarily be a warm sea, around the pole, we should have a variable temperature in the sea-water. 4°. There is less than 1,300 miles of this unexplored region on a line drawn from Lockwood's highest, over the pole, to North-east cape, Siberia. Now, if there were a sea of warm water in this comparatively small space, we should have in the region surrounding it a meteorological condition which does not exist. We should have a vast amount of precipitation during the winter, with cloudy weather; instead of the clear dry weather, with frequent calms, that we do experience. And the amount of precipitation decreases as you go north.

The difference in temperature between the flood

and ebb tide, noticed by Lieut. Greely, I think is explained by the fact, that, to the south of Robeson Channel, the sound is kept open more or less by a strong current, and the water so exposed loses more of its latent heat in the winter than that to the north where it is protected by the ice-cap; and as the difference was only about .2 of 1°, it may be there is a difference of density. As to Mr. Cremin's theory that the flattening of the earth at the poles brings the outer crust nearer to the internal fires of the earth, I can only say that I know it to be a fact that the surface indications within the arctic circle do not bear him out in his theory. As it is a well-known fact that the earth north of the arctic circle is perpetually frozen to a great depth, and as the earth probably cooled from the surface, it is fair to presume that it at least cooled as fast at the poles as at the equator; and I think that a residence of a year or two will convince any reasonable man that the crust is tolerably thick up there, if extreme cold has any thing to do with it.

P. H. RAY.

Washington, Sept. 13.

Discrediting American science.

On p. 48 of the current volume of *Science* you take occasion to say, —

"Work of value upon the subject of micro-organisms is not done in this country, nor will it be until some such encouragement is offered to investigators as is the case in France and Germany. This kind of research requires the rare combination of many forms of training, added to a critical, analytical, and judicial mind. These we can have; but until the facilities for work are offered, until the necessity for personal sacrifice and self-denial is done away with, we can hope for no better work in the future than has been done in the past: in other words, what is first needed in order to place our own investigations upon an equality with those of the two countries mentioned above, is a thoroughly equipped, fully endowed laboratory, with a strong corps of well-trained and salaried officials."

Now, while you doubtless had in mind, when penning this paragraph, the great desirability of more systematic investigation in this country of those plagues of mankind which annually cut short so many valuable lives, I cannot allow this sweeping and unjust assertion to pass unnoticed, and to stand as a disparagement to American science and a reproach to American investigators. Whether you realize it or not, it is nevertheless a fact, that the patient student of micro-organisms in this country has been laboring under the enormous disadvantage that his work, however valuable it may be, is discredited at home, and unnoticed abroad, while the most absurd generalizations of the European worker are received with approval there, and enthusiasm here.

Sternberg has worked for years on intermittent fever, tuberculosis, septicaemia, yellow-fever, germicides and allied subjects; and, beyond his own writings and the reviews of his books, what is there in American literature to show that such a man has existed? About the time that Pasteur announced the discovery of his now celebrated 'new disease' produced by inoculating rabbits with the saliva of a child dead of hydrophobia, Sternberg demonstrated the virulence of normal human saliva when rabbits were inoculated with it.[1] He also demonstrated beyond question that this was due to a micrococcus which might be cultivated to the eighth culture without losing its virulence, and even showed that an immunity might be granted by protective inoculation.[1] Both had been working at the same time with the same organism, and had reached substantially the same result. Pasteur's work was published as something remarkable the world over; while Sternberg's — well, we must admit it received some credit abroad, even if it fell flat at home. Again: Sternberg's tests of germicides are, perhaps, the most extensive and satisfactory investigations in this line that have ever been made. He was certainly one of the first who attempted to obtain exact results by allowing a disinfectant of a given strength to act on a particular disease-germ for a given length of time, and then tested his results by cultivation and inoculation experiments.[2] And surely his experiments and results in photographing micro-organisms cannot be set down as entirely valueless.[3]

A short time ago the rather absurd speculations of Tyndall, in regard to the nature of the immunity from contagious diseases which is conferred by a previous attack, attracted wide-spread attention both in Eurôpe and America. Tyndall's views were based upon the theories of Pasteur; and these, in turn, rested upon a very narrow basis of experimentation with fowl-cholera, which, at the time they were put forth, were far-fetched, and now are antiquated. Pasteur is a chemist, and Tyndall a physicist; and neither has any adequate conception of the fact that there are processes going on in the animal body which both chemistry and physics are incompetent to explain. Pasteur's chemical explanation of the mystery of immunity — that it was the exhaustion from the body of something necessary for the nutrition of the virulent germ; something that, once exhausted, was not again replaced — had a great fascination for the great English physicist, and he received it with childlike trust. What objection could there be, indeed, from his stand-point, to the view that a living body may be compared in every respect with the test-tube and the flask with which he is in the habit of experimenting in his laboratory? And when a Frenchman and an Englishman unite in pressing so plausible a theory, we surely could hardly expect from past experience that the American scientific editor would pay much attention to the vulgar home worker, no matter how striking his experiments, or how conclusive his demonstrations. I trust, however, you will pardon me for calling your attention to the fact that more than two years ago I demonstrated that immunity was only relative, and never absolute; that the most susceptible individual possessed a certain degree of immunity which can be accurately measured; and that all degrees of immunity may be overcome by a sufficient increase in the dose of virus. The immunity of the animal body, then, in no sense resembles the exhausted cultivation-liquid in the flasks of Pasteur and Tyndall, which no increase in the amount of virulent material added can ever induce to support the development of new generations of the microbe; and the honor of demonstrating this radical difference is due to American investigations.

I went farther than this, however, and showed that this theory of our European friends was absolutely untenable; because broth made with distilled water from the flesh of an animal that had been granted a very complete immunity was just as favorable a medium for the growth of the virus as that made from

[1] Bulletin of National board of health, April 30, 1881.

[1] Bacteria. By Dr. ANTOINE MAGNIN and GEORGE M. STERNBERG, M.D., F.R.M.S. New York, *William Wood & Co.*, 1884. pp. 355-376.

[2] *Ibid.*, pp. 209-235. National board of health bulletin, July 23, 1881.

[3] Photo-micrographs, etc. By GEORGE M. STERNBERG, M.D. New York, *William Wood & Co.*, 1884.

susceptible animals; and that such virus lost nothing in virulence by being grown in such a medium.[1] I will not trouble you with the theory of immunity which I developed from these experiments. Like other American work, it may have no value; but it may interest you to know that an able German writer in the last number of Virchow's *Archiv* has propounded a theory, which, in its most important points, is identical with my own.

In 1880 Mr. Chauveau published some observations and experiments which indicated that even a very virulent virus of a fatal disease might be made to produce a mild attack, if the dose administered was sufficiently small. About the same time I demonstrated by more numerous and direct experiments that this was true; but I went beyond this, and have the incontestible priority of demonstrating, —

1. That a certain number of the most virulent and fatal germs may be introduced into the most susceptible body without producing the least appreciable effect;[2]

2. That by increasing this number slightly, but still using a relatively small dose, germs which ordinarily multiplied throughout the whole body, and produced a constitutional disease, may be compelled to multiply locally, and cause only an insignificant local lesion without constitutional symptoms;[3]

3. That this local multiplication confers an immunity upon the whole body;[4]

4. That the immunity produced by a single inoculation with this diluted virus equals that produced by two inoculations with Pasteur's attenuated virus.[5]

Again: when Pasteur announced his discovery of the method of attenuating the virus of fowl-cholera, he coupled it with the theory that this attenuation was due to the action of atmospheric oxygen; and, although the evidence in favor of this theory was neither direct nor abundant, what there was of it came direct from Paris, and this was sufficient to secure it universal attention and unqualified indorsement at the hands of scientific editors. A few experiments led me to conclude, however, that this theory was incorrect, that the attenuation could be secured in the absence of oxygen as well as in its presence, and that it was really due to loss of vitality, the result of keeping the germs for a considerable time under unfavorable conditions of life.[6]

It is true that these conclusions did not receive the least notice, favorable or unfavorable, either at home or abroad; but, as they have since been established beyond question by the elaborate researches of Chauveau and others, I am inclined to think that the fault was neither with me nor my experiments, but that it is confined to the fact of the work being done by an Ameri[illegible], and on American soil.

I need no more [illegible] call your attention here to the fact that I dem[illegible]ated which one of the several germs that had be[illegible]ribed as peculiar to swine-plague was the actu[illegible]e of the disease, and that this was more than [illegible]ar before the same experiments were duplicat[illegible]y Pasteur and his assistants, who, nevertheless, succeeded in bearing off the honors that belonged to the American discoverer. This subject was placed before your readers in sufficient detail in a recent number of *Science*.[7]

In regard to the peculiarities of the germ of fowl-cholera, and the exact effect of disinfectants and various conditions of existence upon it, you will find in my reports the record of nearly one hundred and fifty experiments which it has seemed to me might have a little, though possibly a very slight, value from the light which they throw upon the germ-theory in general, and especially upon that group of diseases caused by organisms which do not form spores.[1]

The admirers of Koch are ever on the alert for an opportunity to enlarge upon the perfection of his apparatus and the security of his processes. They forget, however, that the most satisfactory work which he ever did, that which raised him from an obscure physician to be an acknowledged scientific authority, was accomplished with an apparatus so primitive and imperfect, that, were any one to use it to-day, it would only create ridicule and contempt. I refer to his cultivations of the bacillus anthracis in unsterilized liquid on ordinary microscopic slides, placed over wet sand in a soup-plate to prevent evaporation, covered with a plate of glass, and warmed over an oil-lamp. His disciples can, perhaps, afford to criticise imperfect apparatus now; but it may not be out of place to remind them, that, if their master's first work had been rejected on this account, he would probably still be an unknown physician in an obscure German hamlet.

After all, what is there in Koch's method of cultivation on the surface of solid media that makes it preferable, or even equal, for general purposes, to cultivation in liquids? Is any scientific man at this day so ignorant as to believe that the intermittent heating of blood-serum for half a dozen times to 137° F. (58° C.) is sufficient to safely sterilize it?[2] Is it not an incontestible fact that cultivations on solid substances cannot be made, examined, and reproduced, without exposing a large surface to contact with unsterilized air and the countless germs which it contains?

It is not my desire, however, to detract in any way from the well-earned reputation of Dr. Koch and Mr. Pasteur (there is no danger that they will ever receive too much honor); but, when American science is sneered at and rejected because of alleged imperfections, one can scarcely avoid calling attention to the fact that Europeans also are fallible, and their methods not beyond criticism.

You do not seem to be aware, Mr. Editor, of the fact that appropriations for the investigation of the contagious diseases of animals have been made on a liberal scale for the past six years, and that a considerable part of this money has been used in the study of micro-organisms. The results of these investigations have been so satisfactory to the people at large and to congress, that a permanent bureau was established at the last session, a part of the duties of which is to continue this line of research. I have had a laboratory and an experiment-station under my direction in Washington for more than a year. And while I am willing to admit fallibility and imperfections, if one can judge from scientific articles and from the reports of those who have visited the laboratories of Koch and Pasteur, I see no reason why we should fear a comparison of our laboratory, apparatus, and methods, with those in use on the other side of the water.

It is true that the enormous development of our animal industries brings up a multitude of inquiries foreign to the subject of micro-organisms, which

1 Department of agriculture, Annual report, 1881 and 1882, pp. 283–300.
2 Department of agriculture, Annual report, 1883, p. 48.
3 *Ibid.*, 1881 and 1882, pp. 285–288; also 1883, pp. 44–49.
4 *Ibid.*, 1881 and 1882, p. 288.
5 *Ibid.*, 1881 and 1882, p. 288.
6 *Ibid.*, 1881 and 1882, pp. 283, 284.
7 *Science*, iii. p. 155.

1 Department of agriculture, Annual report, 1880. *Ibid.*, 1881 and 1882, pp. 272–300. *Ibid.*, 1883, pp. 44–52.
2 Les organismes vivants de l'atmosphère (P. Miquel, Paris, 1883), footnote, pp. 134, 135. Department of agriculture, Annual report, 1881 and 1882, p. 284.

divides the time of the director, and distracts his attention; but we are endeavoring to overcome these difficulties by a division of labor; and when the new bureau is fairly organized, and running smoothly, we hope, if not to satisfy all, at least to keep adding to our knowledge of animal contagia until we are able to combat them successfully.

A few weeks ago, in a review of the last report of the department of agriculture (*Science*, iii. pp. 689, 690), you took occasion, while speaking very kindly of the work that had been done, to intimate that the proposed investigations for the discovery and supply of vaccine to be used in preventing contagious diseases were uncalled for and useless; the argument being that the profession could be relied upon to prepare and apply such vaccines if they were of sufficient value.

In reaching this conclusion, you evidently left out of consideration the most important elements of the problem. In the first place, we have but a mere handful of veterinarians in the whole country, and these mostly located in cities where they are of little use in treating the diseases of meat-producing animals: in other words, the stock-raisers of the country are practically beyond private veterinary assistance, and will remain so for years to come. In the second place, there are not more than two or three veterinarians in the country who have had the training, or, indeed, who have any conception of the processes, necessary for the study and cultivation of the group of organisms to which the disease-germs belong. You admit more than this in the editorial to which I referred in the first part of this communication. In the third place, there is nowhere in this world a single man who can tell the exact conditions under which the germs of the diseases that are most dangerous in this country must be cultivated so that they will be safe as vaccines, and at the same time capable of conferring a certain immunity. This must be worked out by long and costly experiments; and surely no individual is likely to be found who will attempt so difficult and dangerous a service at his own expense. In the fourth place, you will observe that even those medicines of which the processes of manufacture are tolerably well known (such as quinia and nitrite of amyl, for instance) are produced by chemists, — specialists, — and not by the medical profession. How much more necessary would it be, then, for specialists to control such delicate manipulations and complicated apparatus as are required in the reproduction of uncontaminated germs, especially when these are to be held at a given point in the scale of virulence. But how can you ask our people to depend upon such specialists in one number, and within a month or two assure them that there is no one in the country who is doing work of value in this direction? If you turn your eyes to Germany, you will see Koch, as a government official, using national appropriations to study the organisms which produce the diseases of men and animals. Turn to France, and you see Pasteur, also by the help of the government, endeavoring to discover methods for the production of vaccines that may be used to prevent animal diseases. Do you see the unassisted veterinary profession in either country accomplishing any thing in this direction, though they vastly excel ours both in numbers and education? Why, then, should not the officials of our government do the same kind of work, and strive to attain the same ends? And, if supplying vaccines to our farmers should prove the most economical and satisfactory means of fighting certain contagious diseases, why should not the agricultural department furnish such vaccines?

Finally, if you are right in your supposition that "there must be some misconception lurking in the minds of the department officials, if they really suppose that the veterinary profession is necessarily incompetent to deal with a problem because, forsooth, the known methods of solving it happen to be delicate and expensive," I would like to ask how it happens that the animal plagues of this country are increasing their ravages from year to year without an effort, on the part of the veterinary profession, to hold them in check? If 'an ordinary citizen' supposes that our future is likely to be different from our past in this respect, he certainly shows a surprising ignorance of the methods that have been found necessary in every country where any success has been achieved.

Is it not our duty to accept great national problems as they actually exist, rather than in the shape they are pictured by the distorted imagination of the editorial philosopher, who comes in contact with germ-diseases in books and periodicals, but never sees them on the farm and the ranch, where their ravages amount to millions and tens of millions of dollars annually?

In closing, permit me to express my personal disappointment at the course which the editor of *Science* has decided to adopt in regard to this branch of our home work. It was expected that this periodical would be a true representative of American science, defending its conquests, and encouraging its workers to renewed exertions. With certain departments it has not failed to do this; but with others, as I trust I have shown in this communication, its only effect has been to discourage and discredit when honest and successful work was being accomplished; and in saying this, I know I am not alone in my opinion, for a number of well-known scientific men have recently expressed to me the same idea.

If, Mr. Editor, this communication is open to the charge of egotism and garrulousness, I hope it will not be forgotten that the American investigator who is overburdened with modesty stands but a poor chance in the struggle for existence with the conditions of environment so decidedly against him.

D. E. SALMON.

[We have but to repeat, that "work of value upon the subject of micro-organisms is not done in this country." If all work upon micro-organisms that any observer chooses to publish — the result of unskilled labor — is of value, then we have doubtless cast an unwarranted slur upon American investigators. If, on the other hand, only that work is of value in this field which is the result of untiring industry, long training, and judicial criticism, then our remark was just. To be of value, such work must be *complete* in all its details; and the relationship between a bacterium and a pathological process must be established beyond a reasonable doubt, provided the methods are correct, and there has been no error of observation. It remains to be seen whether American work of permanent value in this branch of research will not receive the same hearty recognition from our co-workers abroad as it has in all other branches where our excellence has deserved acknowledgment. In conclusion, we wish to state that we do not care for controversy, nor did we intend to excite it. It was our belief, that, on the whole, we have not yet thoroughly mastered all the requirements necessary for this most delicate branch of investigation, and that a reminder of that fact would do no harm. We sympathize with unrecognized merit, but would console it with the reflection that *Aucun chemin de fleurs ne conduit à la gloire.* — ED.]

THE WORK OF OCTAVE HALLAUER.

THE distinguished physicist and engineer, G. A. Hirn, sends to the writer from his sick-bed, where he has been lying, as his amanuensis pathetically writes, '*malade depuis plus d'un mois*,' a biographical sketch of his hardly less distinguished and talented assistant, Octave Hallauer. This paper was read before the Société industrielle de Mulhouse on the 30th of January last. Mr. Hallauer died on the 5th of December, of typhoid-fever. He was born at Metz, Jan. 21, 1842, was educated there, and received the degree of bachelor of science in 1860. He continued his studies in mathematics, and entered the technical school at Mulhouse at the age of twenty, making a specialty of applied mechanics. He became, at his graduation, an 'apprentice-engineer' at Bitschwiller, in the establishment of Stehelin, and afterward joined Leloutre, the agent of the house of Grafenstaden, as his aid and secretary, at Mulhouse. Later, he became the assistant engineer of the Association des propriétaires d'appareils à vapeur, and afterward, January, 1875, the engineer of the Messrs. Hartmann.

During the Franco-German war, Hallauer served with the French as a lieutenant, and fought in the armies of the Loire, of Orleans, and other sections of the French army of defence. He was present in the deadly fight at Villersexel, and, after the defeat of the army, took his forces across the Jura Mountains, and retired to Lyons, where he arrived, sick and exhausted, with the portion of his command thus saved. Recovering his health, he resumed, at the close of the war, his professional work.

During the campaign, and at intervals, as opportunities offered, Hallauer frequently varied the more serious work which came to him, by the practice of an accomplishment in which he excelled, — that of the painter. His sketch-book was filled with studies of the beautiful scenery of the district in which occurred the operations in which he was engaged.

The long series of experiments upon the steam-engine in which Hallauer engaged, and which have made him famous, were commenced in 1868. The history of the development of the theory of the steam-engine (which now, thanks to the investigations of such men as Hallauer, is at last likely to become soon satisfactorily complete) may be divided, according to Hirn, into three distinct periods: 1°. That in which it was assumed that the heat entering the motor simply traversed the system, unchanged in amount, and acting only by its 'head,' as in the case of falling water, finally reached the condenser without loss in quantity, — simply lowered in temperature, and hence, in head available for purposes of impulsion; 2°. That in which it became recognized, that, in addition to the necessary depression of temperature, there is always, also, an actual loss of heat by transformation into mechanical energy; 3°. The experimental period, — that in which it at last became known that the heat supplied to the engine, in addition to these two changes, becomes seriously modified in its availability by its interaction with the walls of the steam-cylinder; which surfaces take up heat from the entering steam, and transfer it to the exhaust side without deriving from it useful effect.

The first period dates from before the time of Carnot. The second period was opened in 1852 by the labors of Clausius and of Rankine. The third period has only been entered upon within a few years past, the experiments of Hirn and Hallauer having furnished a very important part of the basis for the new treatment of the subject. The writer would distinguish these two later periods as those of the 'ideal' and of the 'real,' in the theory of the steam-engine. Clausius and Rankine, and other writers on the theory of heat-engines, have usually taken no cognizance of the expenditures of steam, other than those involved in the thermodynamic relations of energy, and ignore the usually greater demand for steam to supply wastes of heat in the steam-cylinder by the processes now familiar to every engineer, as invariably occurring in every heat-engine, — those caused by 'cylinder-condensation' and leakage. The latter can be prevented: the former may be ameliorated, but can never be wholly prevented, and will probably rarely, if ever, be reduced to such an extent that it may be neglected in the theory of the engine. It usually takes place to such an extent as to render the values of efficiency of fluid, and of engine, and of estimated 'duty,' obtained by the purely thermodynamic treatment, far from correct, and often very absurd. This fact has in many cases induced practically expert engineers to regard the current works on thermodynamics as devoid of value and practical interest, forgetting that the correct statement and application of one set of natural laws never can be valueless, even when, as here, other laws may be implicated in the same set of phenomena; which may be equally essential to a complete and correct theory, and which laws may be less well determined, and their operation less precisely understood. The first essential step

having been taken, it becomes a duty, not to ignore that, but to seek the knowledge needed before the next step can be taken. In this department also, as in others, the theorist has often failed to realize, that, although his mathematically deduced conclusions indisputably follow from his assumed premises, the latter may be, nevertheless, so far different from the conditions of actual work as to render his deductions practically valueless and absurd.

The last-mentioned of the two classes of phenomena are now becoming well recognized as essential elements in the action of all heat-engines, and it will not be long before investigators now at work will bring into view all the facts needed in the task of tracing out the laws controlling this method of expenditure of heat; and its introduction into the theory of the steam-engine will promptly follow. The writer has already endeavored to frame a closely approximate theory of the steam-engine on this basis, using the facts already known, and taking expressions for this method of waste which experiments already made indicate to be tolerably exact; sufficiently so to permit their use in design until further research shall give us more precise, though perhaps less convenient, expressions. The results so attained accord very satisfactorily with experience. This last period in the history of the theory of heat-engines has been inaugurated by the very valuable labors in Great Britain of Professor Cotterill, who seems to have been the first author to take up the new phase of the subject with the intention of making practically useful application of existing knowledge; and, on the continent of Europe, by the interesting, if somewhat warm, discussion of the defects of the theory of the second period, between Messrs. Hirn and Hallauer, on the one hand, and Professor Zeuner, on the other; and also, in this country, by the attempt to rationalize the accepted theory to which allusion is made above.

The experiments upon which we are to-day dependent in this work of revolutionizing the theory of heat-engines, and which have revealed the limitations to which the economical application of heat as a motor in the steam and other heat engines is subject, began with James Watt, who a hundred and twenty years ago, by his investigation of the action of steam in the cylinder of the Newcomen engine, revealed

the fact and the importance of that waste by cylinder-condensation which is only to-day becoming recognized as an essential element in the theory of the 'real' steam-engine of the engineer, as distinguished from the 'ideal' engine of the authors of the theory of thermodynamics, and which is recognized as imperatively demanding consideration, if that theory is to be made of practical use in engineering. Watt's discovery of this 'cylinder-condensation' led him to the invention of his separate condenser, and of the long-neglected but now familiar steam-jacket, — an attachment which was, for many years, only seen upon the Watt or Cornish engine, and was almost never used elsewhere. It has now come in with the compound engine, and is familiar to every engineer. Watt also found that this action placed an early limit to the gain derivable by expansion.

The work of Watt in the systematic experimental study of the steam-engine was not taken up by his successors in the profession until about the beginning of the present half-century, or a little later, when Hirn in France, and Isherwood and the navy department in this country, began the work which has now become classic. Defective as some of this earlier work may be by some regarded, it was of inestimable value; and Hirn, and his assistant and colleague, Hallauer, will never be forgotten as prominent among the pioneers in this all-important line of research. Mr. D. K. Clarke of Great Britain, one of the first of the new race of engineers, interested alike in theory and in experiment, familiar alike with the science and the practice of engineering, must be placed beside these investigators as having persistently called attention to the loss of energy revealed by them, and by his own investigation of the wastes occurring in the steam-cylinder of the locomotive. This work began, in his case, as long ago as 1855.

Hallauer was one of the first to recognize, and frankly to admit, the defects of the 'ideal' treatment of the theory of the steam-engine, and was as prompt in his acceptance of the inevitable as was his preceptor. As Hirn says, breaking away from the old system, his progress was rapid and satisfactory. Seizing with avidity experimentally determined facts, he held fast to the knowledge thus acquired, and demanded that theory should precisely conform to fact. His work upon the compound engine was especially fruitful; and his knowledge of theory, and his skill in its application, rendered his work at once available. He studied also the data given him by Widmann, relative to the performance of marine engines, and deduced, from his examination of the phenomena here revealed, the proper methods of increasing their efficiency. Uniting, in a rare degree, the practical sense with the intellectual cast of mind of the scientific man, he was able to make his work immediately and most effectively useful.

Referring to his personal character, Hirn describes him as possessing the most admirable qualities. Kindly, affectionate, modest, and yet intellectually great, Hallauer united with these prepossessing characteristics the most irrepressible energy and mental force. The last words in the eulogy by his friend Hirn are those of personal regard and of deepest affection.

Hallauer wrote many papers,[1] the first being an account of the method adopted by Hirn for determining the quality of steam by means of the calorimeter. The greater number were descriptive of his experimental investigations. He was an honorary member of the Société industrielle de Mulhouse, and of the American society of mechanical engineers, and was a member of the Société des ingénieurs civils de Paris. The writer wishes to add to the eulogy of Hirn, if it be possible to so add to it, this tribute of kind remembrance of one who, even were he not so distinguished a colleague in the professional fraternities, would none the less demand the most earnest expression of admiration, esteem, and respect.

ROBERT H. THURSTON.

THE SYNOPTICAL FLORA OF NORTH AMERICA.

THE second portion of Professor Gray's 'Synoptical flora of North America' has appeared, six years after the publication of the first part, which contained the gamopetalous orders following Compositae. The present instalment of this important work — the most important contribution (with the exception, perhaps, of the Genera plantarum of Bentham and Hooker) made in late years to systematic botany — treats of the plants of North America (exclusive of Mexico) belonging to the families which precede those elaborated in the previous volume, which took up the 'Flora' where it was left more than forty years ago, at the end of the second volume of Torrey and Gray's 'Flora.' The present publication is devoted to an elaboration of the families (Caprifoliaceae to Compositae) embraced in the second volume

[1] Published by Gauthier-Villars, Paris.

of the old 'Flora,' and is therefore in a certain sense a new edition of that work, although entirely recast and rewritten.

The present volume is of special importance and value. Its publication has long been looked for with impatience, and its pages will be examined with the deepest interest by all students of American botany. It contains the mature views of the most acute and profound student of the great and difficult order of Compositae, to which not less than one-eighth of all the flowering plants of North America must be referred, — an order, as represented on this continent, to the comprehension of which he has given his best efforts and unflagging industry for more than half a century, and which, it is safe to predict, no other botanist would ever have been able to so elucidate. The plants, belonging to 5 families, 274 genera, and 1,767 species, are characterized in this volume, which contains, exclusive of its very full index, 446 pages, of which all but about 50 are devoted to Compositae, with 237 genera and 1,610 species.

A brief and necessarily imperfect comparison of the families here elaborated, as represented in this country at the present time, with what was known of them when the second volume of Torrey and Gray's 'Flora' appeared, between 1841 and 1843, will show the extent and character of the work which has occupied Professor Gray of late years, and the importance of the service which he has performed, as well as the zeal and industry of the botanical travellers and explorers who have long been busy, under his general direction, in all parts of the country.

Adoxa, transferred from Araliaceae, now appears, represented by its single widely distributed species, among Caprifoliaceae. Additions to Sambucus are S. melanocarpa (of the northern Rocky Mountains) and S. Mexicana (a Mexican species of the boundary and of southern California). The Texas station, near San Antonio, of this tree, is not given. In Viburnum, V. densiflorum — a southern species, as Professor Gray remarks, too near V. aurifolium — is admitted. Symphoricarpus, a North-American genus, is increased by a new, long-flowered section with three species, of the south-western mountains: Lonicera conjugialis of the Sierra forests of California, and L. Utahensis of the northern Rocky Mountains and Utah, are additions to that genus which shows besides many important changes in the rank and position of various species. Important changes appear in Rubiaceae. Loganieae, which appeared in the old 'Flora' as a tribe of this order, is now placed as a family between Asclepiadaceae and Gentianaceae, in the preceding volume. Borreria is reduced to Spermacoce; and Hedyotis is split up among Houstonia, Oldenlandia, and Pentodon. Besides these changes, eight genera not in the old 'Flora' are represented by plants, mostly of West-Indian or Mexican origin, which recent explorations have brought to light in southern Florida and along the Mexican boundary. Kelloggia, a monotypical genus of the Pacific slope, commemorates the botanical labors and zeal of Dr. Albert Kellogg, one of the early explorers of California botany. The large genus Galium is increased from eighteen to thirty-seven species.

In Valerianaceae, Plectritis and Fedia are merged in Valerianella, while the species of Valeriana are increased from six to eight.

The extension and changes in Compositae during the last forty years, as was to have been expected in a family so largely represented in our flora, and of such wide and general distribution, far exceed, in number and importance, the changes in the smaller orders alluded to above.

This order, as represented in North America at the time of the publication of the old 'Flora,' was grouped in eight tribes: in the new elaboration, representatives of eleven tribes appear. It now contains representatives of 237 genera and 1,610 species; while forty years ago there were, within the limits of the region embraced by Torrey and Gray's publication, only 199 genera and 1,011 species. Of the large genera, Aster, which Dr. Gray remarks "is far the most difficult of our genera, both from the settlement of the names of the species and from their limitation, in respect to which little satisfaction has been obtained as the result of long and repeated studies," heads the list with 124 species, — seven less than the author's elaboration of this genus for the old 'Flora.'

This diminution of species is due to the fact that several of the Linnaean species have been dropped, from one cause or another, and because Aster, largely a genus of eastern America, has not received many additions through western explorations. The same remarks are true, too, of Solidago, our second largest genus of Compositae, now represented in our flora by 74 species, although not less than 94 were admitted in the old 'Flora.' Some species have been dropped entirely, and others reduced to varieties; while few new additions to the genus have been made. Erigeron, on the contrary, has been nearly doubled, increasing from

40 to 71 species. Bigelovia, which fifty years ago had a single representative in the Atlantic states, now, as extended, contains 19 species, with its centre of distribution beyond the Rocky Mountains; whence, of late years, have come, of course, the principal additions to our flora. Similar comparisons might be made indefinitely between the composition of our flora as now understood and that of the earlier part of the century, were such comparisons necessary to illustrate the importance of the work under consideration, or to impress upon our readers the sense of our obligations to its author. Were it necessary or proper to say any thing at this time in regard to the part played by Professor Gray in the development of botanical science in this country, it would only be necessary to point to the fact, that, of the North-American Compositae as enumerated in this volume, more than 600 species and 30 genera have been characterized and enrolled by him since the publication of his previous study of the order. Twenty-eight species are first described in this volume.

The present volume, like its predecessor, will be found a model of comprehensive arrangement, and neat, concise, and clear expression. Unlike its predecessor, it bears upon the titlepage, in addition to the names of Professor Gray's New-York, London, and Leipzig publishers, "Published by the Smithsonian institution, Washington," where copies, no doubt, can be obtained, as well as from the author at Cambridge.

THE LANGUAGES OF AFRICA.

A sketch of the modern languages of Africa; accompanied by a language-map. By ROBERT NEEDHAM CUST. London, *Trübner*, 1883. 2 vols. 16+566 p. 8°.

THE Caucasus is styled in the east, from the variety of idioms spoken by the many tribes that are harbored in its recesses, the 'Mountain of languages.' This variety, remarkable as it is, becomes insignificant when compared with that which exists in Africa, which might well be called the 'Continent of languages.' In these volumes of Mr. Cust, we read of no less than five hundred and ninety-one distinct idioms, of which four hundred and thirty-eight are classed as languages, and a hundred and fifty-three as dialects. And even this does not complete the list; for there are several unexplored regions, of whose tribes and languages nothing certain is known.

A closer scrutiny, however, lessens the marvel materially. Of the idioms enumerated, no less than two hundred and forty-eight belong to that portion of the continent which lies south of the equator. All these idioms, as is well known, compose only two linguistic stocks, — the great Bantu family, which occupies the whole of the wide territory explored by Livingstone and Stanley; and the Hottentot-Bushman family, comprising the tribes of dwarfish people who seem to have been the aboriginal inhabitants of South Africa. The Bantu nations now speak, according to Mr. Cust, two hundred and twenty-three languages and dialects. But as philologists have no doubt that all the idioms of the Indo-European stock are the offspring of a primitive mother-tongue, which was at one time spoken by a single tribe, and earlier still by a single household, so we may feel assured that all the languages of the Bantu family have their origin in the speech of a single clan.

There was reason to hope that in Mr. Cust's elaborate work we should find this process of reduction continued, and the vast variety of African tongues brought into the manageable compass of a comparatively few linguistic stocks. This expectation, unfortunately, is not fulfilled. Mr. Cust has chosen to adopt the classification of the eminent ethnologist, Prof. F. Müller, who arranges the languages (or, more properly speaking, the tribes) of Africa in six main divisions, — Semitic, Hamitic, Nuba-Fulah, Negro, Bantu, and Hottentot-Bushman. This arrangement, however, was proposed by the distinguished Viennese professor, not for linguistic, but mainly for ethnological, or rather anthropological, reasons. Only three of these divisions — the Semitic, the Bantu, and the Hottentot-Bushman — are true families. The other three divisions are styled by Mr. Cust, 'groups,' — a word which in comparative philology has, at least as here employed, no scientific meaning whatever. The connection of the tribes composing these groups is not even geographical: it depends merely upon some physical resemblances; and these, it may be affirmed, are not nearly so strong as those which exist between the Hungarians, the Germans, and the Basques, whom no philologist would think of classing together. In fact, the word 'group' in this case is simply, as Mr. Cust frankly admits, a confession of ignorance.

The ignorance which is thus confessed is, on the author's part, to a large extent voluntary. With the immense mass of linguistic materials which he has collected, and which far surpasses all that earlier inquirers have been able to accumulate, nothing would have been more easy

than by a simple collation of vocabularies — aided, where practicable, by grammatical comparisons — to ascertain the relationship of the various idioms, and to reduce them into the families to which they belong. It is probable enough that some isolated languages would be found, like the Basque in Europe and the Khasi in farther India, whose kinship could not at present be determined; and, of course, the 'language-map' would show many vacancies: but these are imperfections which belong to the earlier stages of all investigations. In spite of such drawbacks, a scientific classification could have been made, which would have gone far to bring this linguistic chaos into order, and would have thrown a flood of light upon African ethnology.

But while regretting these deficiencies in Mr. Cust's work, we must be thankful for what we have gained from him, which is not a little. In these two volumes we have a clear and readable account of the present state of African philology, and a complete list of the tribes and languages of the continent, so far as they are now known, with interesting details concerning many of them. The names of all the authors who have written on the subject, and the titles of their productions, are given with commendable fulness and precision. The work displays great industry and conscientious accuracy. The extensive 'language-map,' which has evidently been prepared with much care, aids materially in illustrating the text, and is in itself a most valuable contribution to philological science. In spite of the defects which have been indicated, Mr. Cust's treatise must be pronounced to be by far the best work which we possess on the subject to which it is devoted. Scholars who pursue this important branch of linguistic study will find in these attractive volumes a highly useful, and indeed almost indispensable, guide. H. H.

MINOR BOOK NOTICES.

The development theory: a brief statement for general readers. By Joseph Y. Bergen, jun., and Fanny D. Bergen. Boston, *Lee & Shepard*, 1884. 7+240 p. 24°.

No better evidence of the present general interest in biology could be wanted than is afforded by the growing demand for popular books on evolution. The latest of these is a little treatise of two hundred and forty pages, by Mr. and Mrs. Bergen, in which, to be sure, not much is original, except the form in which the facts are presented, and a few of the examples cited, as the authors confess; but a reading of their book shows that they have given a good deal of thought to the presentation of the chief arguments upon which the modern development theory rests, with so few technicalities as to render it comprehensible to even young readers. With so many books of a similar character already in circulation, only the test of time can show whether this latest one meets, as the authors intended, a real need. So far as one not wholly unfamiliar with the subject can judge, the story is well and simply told.

Calcul des temps de pose et tables photométriques. Par Léon Vidal. Paris, *Gauthier-Villars*, 1884. 114 p. 16°.

This little book is made up very largely of tables, whose object is to enable the photographer, when supplied with a particular form of photometer, to give the correct exposure to his plate under all circumstances. The book is apparently written largely for amateurs in landscape-photography; but whether they will in general be willing to trouble themselves to procure such a photometer, and carry round the tables with them to consult whenever they wish to take a picture, in preference to relying on their judgment, is perhaps questionable. The photometer employed is similar to that used by carbon-printers, depending on the exposure of sensitized silver-paper, and the noting of the tint obtained after a definite time. The author refers to the application of the instrument to the case of enlargement, where it would seem to be more useful than when taking the original negative. There is one serious objection to its employment for the latter purpose, however, which our author seems to have overlooked. This is, that the exposure for a given landscape does not depend wholly on the total amount of light coming from it. If the background is the important portion, a certain definite exposure will be given. If, on the other hand, it is the foreground that is of interest, the same view may require two or even three times the exposure under the same conditions.

Leiddraad bij het onderwijzen en anleeren der dierkunde. Door Dr. Julius MacLeod. Algemeene dierkunde. Met eene titelplaat en 61 door den schrijver gegraaverde figuren. Gent, 1883. 151 p. 12°.

The author of this little school-book has written it in the Dutch language, in the patriotic belief that *dierkunde*, or zoölogy, may be taught in that tongue, which can supply all the necessary terms. The volume is really a

protest against the custom in Belgium of using so many French text-books. He carefully avoids all except real Dutch words: so we have *borstpijp* ('thoracic duct'), *tuschenwervelig* ('intervertebral'), etc., all of which are gathered into an alphabetical list at the end of the volume, where their French equivalents are also given.

The book is devoted almost exclusively to the anatomy and physiology of man as illustrating the general principles of animal life. The author's presentation of the rudiments of his science is excellent; but his illustrations, white lines on a black ground, are neither very clear nor always accurate.

ASSOCIATION OF OFFICIAL AGRICULTURAL CHEMISTS OF THE UNITED STATES.

At a meeting held in Philadelphia, Sept. 8, to consider the formation of a sub-section of agricultural chemistry of the American association, it was deemed inadvisable to apply to the standing committee; but a committee was selected to report a plan for the formation of an association of chemists who are engaged in the analysis of commercial fertilizers.

The committee's report, which was adopted, recommended that the Association of official chemists of the United States should be organized. To membership in this society, chemists of departments of agriculture, state agricultural societies, and boards of official control, are eligible; and each of these organizations is entitled to one vote, through its properly accredited representative, in all matters upon which the society may ballot. All chemists are invited to attend the meetings, and take part in the discussions, without the right to vote. The affairs of the association are managed by an executive committee of five, including a president, vice-president, and secretary (who acts as treasurer). There are also three standing committees, on the determination of phosphoric acid, nitrogen, and potash. They will distribute samples for comparative work, and report the results at the annual meeting, which takes place on the first Tuesday in September of each year, or at any special meetings which may be called.

After the acceptance of the constitution, the following officers were elected: President, Prof. S. W. Johnson of Connecticut; vice-president, Prof. H. C. White of Georgia; secretary and treasurer, Dr. C. W. Dabney, jun., of North Carolina; members of the executive committee, Dr. E. H. Jenkins of Connecticut, Dr. H. W. Wiley of Washington. The presiding officer then appointed the following members of the standing committees: On phosphoric acid, Dr. E. H. Jenkins of Connecticut, Dr. H. C. White of Georgia, Dr. W. C. Stubbs of Alabama; on nitrogen, Mr. P. E. Chazal of South Carolina, Dr. A. T. Neale of New Jersey, Prof. J. A. Myers of Mississippi; on potash, Dr. H. W. Wiley of Washington, Mr. J. W. Gascoyne of Virginia, Mr. Clifford Richardson of Washington.

It was voted to adopt provisionally the Atlanta method for the determination of the various forms of phosphoric acid, involving the use of the usual neutral citrate solution at a temperature of 65° C. for a half-hour. The recommendations of Dr. Jenkins in regard to potash estimation were accepted; and Mr. P. E. Chazal of Columbia, S.C., was directed to have the proceedings and methods of the association printed for distribution among those who are interested in the subject.

THE AMERICAN HISTORICAL ASSOCIATION.

In response to a call issued by Gen. Eaton and F. B. Sanborn of the Social science association, and by Professors Adams of Ann Arbor, Tyler of Cornell, and Dr. H. B. Adams of Baltimore, about twenty writers, students, and teachers of history in this country met at the United States hotel, Saratoga, on the morning of Sept. 9, and decided to form an independent organization for the advancement of the scientific study of history on this continent. Among others present at this and later sessions, were President White of Cornell; Charles Deane, LL.D., of Cambridge; Justin Winsor, librarian of Harvard university; General Walker of the Massachusetts institute of technology; William B. Weeden of Providence; Clarence W. Bowen of the New-York *Independent;* Professors C. K. Adams of Ann Arbor, Tyler, Crane, and Tuttle of Cornell, Austin Scott of Rutgers, Emerton of Harvard; Associate-professor H. B. Adams of Johns Hopkins; Dr. Channing and Dr. Francke of Harvard. Justin Winsor was elected temporary president, with Dr. H. B. Adams secretary.

In the afternoon President White of Cornell delivered the opening address in Putnam hall. He advocated a broader treatment of historical topics than is at present followed. Not that he undervalued the work of the specialist; but he thought that a view of the historical work now going on in the world showed the necessity of connecting critical analysis, on the one hand, with a synthesis of results on the other. Instruction in history, which is growing of more importance every day, should include both methods. He severely criticised Herbert Spencer's theory of historical study as confounding a mere search for statistics with the real study of the forces of civilization.

Professor C. K. Adams read a long paper, written by one of his pupils, in which the actions of several western states with regard to the lands which the nation had given them for purposes of collegiate education were most justly denounced.

Wednesday morning another session was held, at which a constitution was adopted, and permanent officers elected: Andrew D. White, president; Justin Winsor and C. K. Adams, vice-presidents; H. B. Adams, secretary; and C. W. Bowen, treasurer. The affairs of the association were confided to the care of an executive council consisting of the above *ex officio*,

Moses Coit Tyler, W. B. Weeden,
...on.
...ning of Harvard college then read
...he maintained that the early set-
...North-American colonies did not
...the experience in the management
...hich they had inherited from their
...h formed one of the most precious
...the English race; but that they
...perience to this country, and there
...as the peculiar conditions of their
...ld permit. He further said, that he
...h common-law parish of 1600 was
...ent connecting link between the
...English race in their two homes;
...examples of this connection. Dr.
...gave the pith of the argument ad-
...Aldrich, at a recent meeting of the
...ety, that the New-England town
...a legislative creation. Dr. H. B.
...in his opinion there was not one
...of New England which did not have
...the institutions of old England, and
...the author of the paper under discus-
...the connecting link. Judge Cham-
...Boston public library endeavored to
...two theories were not inconsistent,
...experience that the New-England
...ought with them to a grain of English
...when planted in our soil reproduced
...as circumstances would permit. Presi-
...in closing the discussion, remarked that
...the paper an example of the union
...and synthetic methods which he had
...

...Livermore of Johns Hopkins then read
...on the founders of New Haven, — John
...Theophilus Eaton, — who had strength-
...distinctions at the outset in their colony,
...ted a ruling caste of Brahmins.
...M. Crane of Cornell described some new
...mediaeval history which he has recently
... He thought the field would be an attrac-
...th from the large amount of new material,
...from the new methods applied to old mate-
...as local traditions, popular songs, and folk-
...h often contained details not to be found
...history. A still more curious source was
...ions of stories with which the preachers of
...enlivened their sermons; each in itself of
..., but forming, *en bloc*, invaluable material
...historian. This new method of study would
...t favorably upon the study of our own his-
...d encourage the collection of local traditions,
...gs, and tales; of which an excellent beginning
...n made in Allen's Slave songs of the South,
...ewell's Songs and games of American children.
...ent White spoke of the importance of Profes-
...s work, and then introduced Dr. Francke
...d college; who described the founding and
...f the *Monumenta Germaniae*, with which
...n associated for two years. Justin Winsor
...session with an account of the Narrative
and critical history of America that he is now editing, and of which two volumes are already printed although not published.

At a public session in the afternoon, Professor Tyler of Cornell presented a rather commonplace and eulogistic paper upon the influence of Thomas Paine on the declaration of independence; and Professor Austin Scott — formerly associated with George Bancroft — read an essay on the constitutional development of the United States. The intense heat interfered with the author's delivery, and also with the taking of notes; but it may be said that the author maintained that what he termed the federative principle was the key to our constitutional history, and he traced its action with great care and detail through the successive periods of our national growth. It is to be hoped that Mr. Scott will still further elaborate and publish his paper, which showed considerable ability and thought.

NOTES ON THE ELECTRICAL CONFERENCE.

The Electrical conference, called together by the commission appointed by the president of the United States, met in Philadelphia on Monday, Sept. 8, and continued its sessions throughout the week. The first meetings were held in the lecture-hall of the Electrical exhibition; but on account of the bad acoustic properties of that room, the sessions after Tuesday took place in the hall of the Franklin institute.

About one hundred and seventy-five delegates were invited by this commission to be present, and constitute the conference. Of these the greater number were American investigators and electricians, but a number of foreign conferrees were also included. Of these it should be mentioned, that there were present Sir William Thomson, who was also vice-president of the conference; Professor Fitzgerald of the University of Dublin; Professor Oliver Lodge of Liverpool; Mr. W. H. Preece of the English postal telegraph; Professor Arthur Schuster of Manchester; and Professor Silvanus P. Thompson of University college, Bristol.

The conference was designed to be representative of all interested in progress in electrical knowledge; and so not only were those present who are more concerned with the purely theoretical questions involved, but also those especially occupied in developing applications of electricity.

Prof. Simon Newcomb, on behalf of the commission, opened the conference in a brief address of welcome, and also stated the objects for which the conference had been called. He was followed by the president of the conference, Prof. Henry A. Rowland, who delivered a carefully prepared and very interesting address, in which were discussed, among other things, the interdependence of applied and pure science, some of the questions still open in electrical science, and the need of more careful training in the *theory* of electricity in technical schools.

Sir William Thomson then made a short address, after which the conference adjourned to meet on Tuesday, when the regular discussions were begun.

The object of the conference was to take authoritative action respecting the electrical standards recommended by the international convention; to consider the advisability of recommending the establishment by the government of a bureau of physical standards; to consider what could be done by the U. S. signal-service, with the co-operation of the various telegraph and telephone companies, towards increasing our knowledge of atmospheric electricity and earth-currents; and to discuss subjects in which the knowledge possessed by those acquainted with the theory of electricity could be brought to the aid of those engaged in the applications of the science. The sentiment of the conference was in favor of adopting the electrical standards recommended by the international convention which met at Paris last April; but, as considerable difference of opinion exists as to the best standard of light to be adopted, the whole subject of the electrical standards was referred to a committee which is to report to the commission within three months. In the discussion of the adoption of the legal ohm, as defined by the Paris convention as the resistance of a column of pure mercury at zero degrees centigrade, of one square millimetre cross-section and one hundred and six centimetres in length, it was brought out that the results obtained in the experiments which have been carried on during the past year under Professor Rowland's direction, give very nearly 106.28 centimetres as the length of the column of mercury which represents the *true* ohm.

The subject of the best methods of extending our knowledge of atmospheric electricity and earth-currents, and any possible relation that may exist between them and the weather, was introduced by Professor Abbe of the signal-service. He represented the importance of the subject, and that by using suitable methods, and by the co-operation of the various telephone and telegraph companies, much valuable information might be obtained, and without interfering with the regular work of the lines employed. Sir William Thomson called attention to the fact, that in the study of earth-currents the quantity to be measured is the difference of potential between the points of observation. By such measurements the distribution of potential at any time over the country examined may be mapped and studied.

The question of the establishment of a bureau of physical standards was introduced by Professor Snyder, who pointed out the advantages which would result from having physical standards preserved and verified under government supervision. Work which is now being done by different observers all over the country, and in a way which is often necessarily incomplete from the lack of funds, could thus be done at a central laboratory, more cheaply, effectively, and accurately; and thus the physicists now engaged in these laborious determinations and comparisons would be free to occupy themselves with investigations looking to the discovery of new truth. In the discussion which followed, Professor Rogers of Cambridge, Mass., urged that the bureau should engage in auxiliary research, and showed how this was necessary for the accurate establishment of units. Lieut. Allen of the signal-service read a paper giving an account of the success that had attended the work of that department in obtaining accurate standards for thermometry and barometry. Professor Hilgard, superintendent of the U. S. coast-survey, was not in favor of such a bureau, on the ground that it would discourage private research, and that the present bureau of weights and measures met every requirement. Professor Simon Newcomb spoke in favor of the proposed bureau; and Sir William Thomson not only favored the idea, but thought that instruments of the accuracy required by such a bureau for its work would soon be devised and constructed, and the time was therefore ripe for such action to be taken. Finally the conference adopted a resolution to the effect that it deemed it of national importance that Congress should fix standards of electrical measures, and establish a bureau charged with the duty of examining and verifying instruments for electrical and other physical measurements. The commission was urged to bring the matter before congress; and it was left with them to decide upon the manner of the carrying-out of the idea, whether by a special bureau, or by enlarging the powers and duties of existing departments.

Among the discussions that occupied the attention of the conference, perhaps the most interesting one was that opened by Prof. Henry A. Rowland, upon the theory of the dynamo-electric machine. Professor Rowland maintained, that, neglecting the question of strength and rigidity and other such mechanical reasons, a single magnetic circuit is better than a double one: meaning, by a single magnetic circuit, such a one as would be obtained by placing the armature between the poles of an ordinary horse-shoe magnet; and by a double magnetic circuit, one of the form obtained by putting two horseshoe magnets end to end with their similar poles together, and putting the armature between the compound north and south poles thus formed. In the single circuit the lines of force, after passing through the armature, can only return in one way through the magnet; in the double circuit, however, the lines of force can return by passing around either through one magnet or the other. Professor Rowland is of the opinion that there is far more leakage of the lines of force in the case of the double circuit than in the case of the single; and therefore, other things being equal, the single circuit is the better form. This is, however, a question that should be investigated by experiment. Both forms of dynamo should be carefully examined to determine the amount of leakage at every point. Such an investigation would be very important. Professor Rowland also advocated the use of magnets of cylindrical section, rather than flat or oval magnets, on the ground that the least amount of wire would then be used to produce the required magnetization of a given mass of iron. Professor Silvanus P. Thomson differed on this point, and preferred iron cores of oval section; giving as his reason, that he had found

by actual experiment that the central part of an iron core was not nearly so powerfully magnetized as the outer part. Professor Rowland called attention to the fact that Professor Thompson's experiments had been made with short straight iron magnets, where the resistance of the air to the magnetic lines of force came in as the most important factor, and therefore had led Professor Thompson into error; but that since in the dynamo the only air-spaces are those between the armature and the pole pieces, it closely resembles a ring magnet, where the magnetic circuit is completed in the iron itself, and therefore, as in the ring magnet, the iron in the centre of the core of the magnets of the dynamo is quite as important as that on the outside.

Professor Fitzgerald of Dublin showed that the loss due to self-induction in the armature is proportional to the linear velocity and length of the coils.

Professor Silvanus P. Thompson of Bristol called attention to the fact, that, whenever a coil is short-circuited, there is a real loss of energy in heat; and therefore it is bad to set two brushes, one a little ahead of the other, to reduce sparking, for this prolongs the time during which the single coils are short-circuited. He also noticed that since self-induction is increased in proportion to the increase in the velocity of the armature, or to the increase in the number of turns of wire which it contains, higher electro-motive force is to be best obtained by strengthening the magnetic field. The speaker then referred to the great importance of using the best soft iron in the field-magnets, instead of cast iron; stating that an English maker had nearly doubled the capacity of a machine by substituting for its old cast-iron magnets and pole-pieces new ones made of best forged iron. Professor Thompson even went so far as to say, that, in his opinion, it was important that the *grain* of the iron should run in the same direction as the lines of magnetic force. The speaker also objected to the use of large masses of iron in the magnets, on the ground that the great time required for such masses to come to their full degree of magnetization interfered with their government. Professor Elihu Thomson, on the other hand, stated that when the iron masses were small, the extra current from the machine had so high an electro-motive force as to make trouble, and, when the machine was used for arc-lights, even caused a sort of vibration in their intensity.

Prof. F. E. Nipher of Washington University, St. Louis, opened the discussion of the electrical transmission of energy by a discussion of the case of two dynamos, one being used as a generator, and one as a motor. He showed that the performance of such a system could be advantageously studied by a series of three surfaces; in each surface two of the variables being the speeds of the two machines, and the third variable being in the three surfaces respectively, the work supplied to the generator, the work done by the motor, and the efficiency of the system as indicated by the ratio of these two quantities of work.

The question of storage-batteries was discussed at considerable length. Mr. W. H. Preece of London opened by a paper upon the subject, giving his experience in the use of cells of the Planté form. He has these cells in his house; using electricity not only for lighting, but in many other ways. The cells are charged for two hours every day by a dynamo machine; but he hopes, when the cells are in a little better condition than now, to have to charge them only once a week. Each cell is made up of twelve sheets of lead about a foot square, and separated by thin sheets of hard rubber punched full of holes; the alternate plates are joined together, thus forming two sets of six plates each. Professor Dewar of Cambridge, England, gave an account of the chemistry of the storage-cell, which was of very great interest. There was considerable general discussion upon the subject of the storage-battery, and there still seems to be much to be cleared up in regard to its action. The chemical actions are by no means simple.

The subject of long-distance telephony and the difficulties that attend it was introduced by Mr. T. D. Lockwood, who in a long and interesting paper gave the results of a great deal of experience with long telephone lines. Some interesting points were brought out. The noises on telephone-lines arise not only from electro-static and electro-dynamic induction, but also from earth-currents and atmospheric electricity, imperfect contacts, and leakage from other lines. Long lines are, of course, more subject to these troubles than short ones; and lines running north and south are more subject to disturbance than those running east and west. Sometimes one end of a line will be noisy and the other quiet, as between Chicago and Milwaukee, where the Chicago end is very quiet, but the Milwaukee terminal is very noisy. Lines subject to pretty uniform leakage are less noisy than well-insulated ones; perhaps, for this reason, lines near the sea are quieter than those inland. Lines on high or mountainous land are subject to periodic storms, the noises being most intense at certain hours of the day. Lines constructed of wire of high conductivity are less noisy than those of greater resistance. Lines of small wire, thus having less electro-static capacity, are less noisy than lines of large wire. A good method of treating a noisy line is to provide a metallic return-circuit, hung parallel to the first, and similarly to it. Many of the sources of disturbance will thus be gotten rid of. In case of a long air-line, ending in a short underground cable, the person at the end of the cable can make himself heard at the other end of the line, but the man at the end of the long line can not make himself heard. For short lines, less than two miles in length, cables of insulated wire covered with tinfoil, this covering being grounded, are useful, and get rid of some sources of disturbance; but, on account of the large capacity of such a line, the retardation is very great.

Professor Fitzgerald, who was expecting to give an abstract of the paper read by Lord Rayleigh before the British association, on the subject of long-distance telephony, had been obliged to leave, so no complete presentation of Lord Rayleigh's results could be obtained: but Professor Rowland made a brief statement of the nature of the problem, that

the passage of the wave-current propagating the telephonic action was exactly similar to the sinking of the heat-waves into the earth, treated by Fourier; and by reasoning from the nature of that wave propagation he concluded that the sound of a deep bass voice could be heard farther than that of a high-pitched voice. Mr. Lockwood said that experience in ocean-cable telegraphy confirmed this. Professor Carhart stated that Lord Rayleigh had from similar considerations calculated the farthest distance at which telephonic communication could be maintained in such a cable as the Atlantic cable, and gives the extreme limit as twenty miles. This is fully confirmed by experience, according to the testimony of Messrs. Preece and Lockwood.

Capt. O. E. Michaelis, of the Frankford arsenal, read a paper in which he recommended the study of the 'structural metals,' iron, copper, brass, etc., by electrical or magnetic methods, with a view to ascertaining whether some such methods could not be devised that should detect weaknesses not otherwise to be discovered.

A short discussion then took place, on the measurement of large currents, in which there was nothing particulary interesting brought out.

Professor Rowland then took up the subject of lightning protection, and gave a short development of Maxwell's suggestion that the house should be placed in a metallic cage. A house in a complete metallic cage, one enclosing it *below* as well as above, would be completely protected if the wires of the cage were sufficiently good conductors. This fact leads to the following considerations. Lightning-rods should run down the four corners of the house and across the angles of the roof, joining at the top, thus forming the skeleton of a cage. If rods are also run down the middle of the sides of the house, or if, in a long building, two or three equidistant rods are run down the sides and connected with the rods running across the roof, so much the better. These rods must be *well* grounded, otherwise they are of no use at all, and may be worse than useless; for, suppose the gas-pipes running through the house have good earth connections, the lightning will be likely to leap from the rods to the gas-pipes, and so cause destruction. The rods down the sides should therefore be connected by rods running across *under* the building, as well as by those over the roof; and the gas and water pipes, as well as all large masses of metal in the building, should be connected with the rods by good conductors. It is, of course, necessary that the rods should be of good conducting material, — solid, not hollow. As it is important that the rods should have a large cross-section, the twisted forms with large surface and very little mass of metal are not good, as there is no use in the twisting, and the most important thing is that there should be plenty of metal to conduct. There is not the slightest necessity for insulating a lightning-rod: the safety of a building depends only on its being easier for the lightning to go around it than to go through it. Of course, from the cage of rods above described, small rods bearing points are to rise at different points on the roof. How high these should be, or how close together, is not very well determined. It is considered by some, that a rod protects the space included in the cone whose height is that of the rod, and the radius of whose base is also equal to the length of the rod. Others think that a space is protected equal to the cone whose height is that of the rod, and whose base has a radius of twice that amount.

The time for adjournment having come, the conference adjourned, subject to the call of the chairman, Professor Rowland, who is also president of the commission.

It is possible that there may be another session in Philadelphia about the close of November.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF ANTHROPOLOGY.

The admirable survey of the progress of anthropological science, comprised in the address made by Dr. Tylor as president of the section, was listened to with great satisfaction by the members. In this association, as in the American, anthropology has been late in finding the recognition which its importance as a science deserves. Heretofore it has been treated as a department of the biological section. As the communications have gradually taken a wider range, and become more numerous, it was found that this subordinate status was inconvenient. At the present meeting, anthropology for the first time takes the rank of a section, and with a fortunate choice of officers, — the vice-presidents being Professors Boyd Dawkins and Dr. Daniel Wilson, and the secretaries Messrs. G. W. Bloxam (recorder), Rev. J. Campbell, Walter Hurst, and J. M. P. Lemoine.

Among the papers which attracted most attention may be ranked that of Professor Boyd Dawkins, on the range of the Eskimo in space and time. In this paper Professor Dawkins again urged with much ingenuity and force his well-known opinions as to the probability that the Eskimos are the survivors of the prehistoric race known in Europe as the 'cave-dwellers.' The Eskimos are found along the Arctic Ocean, from Labrador and Greenland to the west coast, and thence extending into Asia. Everywhere they appear to be a receding race, gradually retreating northward as they are pressed by stronger and more warlike tribes, — in America by the Indians, in Asia by the Mongols. The researches of Mr. Dall had produced evidence that they formerly dwelt on the west coast of America, far south of their present

limit. In Asia some linguistic evidence, in Professor Dawkins's opinion, showed an intercourse or intermingling between them and the Mongols, at points far to the south-west of their present abode. He did not consider that the mere fact that they spoke an agglutinative language could be regarded as evidence that they were akin to the Indians. In appearance, character, and customs, they were a distinct race; and there was a strong antipathy between them and the Indians, resulting in frequent hostilities. In fact, a wide belt of debatable land was always left between the two races. In Asia their relations with their southern neighbors were more pacific.

In dealing with the range of the Eskimos in time, we pass from the historic ground into the domain of geology. We have to go back to the 'cave-men,' as they are styled, whose traces are found not only in caves, but along the course of rivers and in other localities. They dressed in skins, and wore long gloves. They were skilled in the use of the needle, which was made of bone. They wore necklaces; they painted their faces. They manufactured skin-scrapers, harpoons, lance-heads, and other implements, of stone and bone. They were manifestly a race of hunters and fishermen, of a rather superior type. They were also artists of no mean skill, as a sketch of a reindeer and the outline of the head of an elephant (of both of which copies were exhibited) fully testified. Of human remains belonging to this race, there was unfortunately an almost entire lack. Professor Dawkins did not believe that any of the skeletons or crania usually referred to this people really belonged to them. There was every reason to think that they did not bury their dead, but left them to be devoured by the wild beasts, and especially the hyenas which then abounded in southern Europe.

This and all the other characteristics of the cave-dwellers are precisely those of the Eskimos of the present day. They are hunters and fishermen, wearing skin dresses with long gloves, are highly artistic in their tastes, and do not bury their dead. If the question is asked, how they came to emigrate to America, it must be remembered that the same question applied to the mammoth which they hunted. Remains of this animal are found in great abundance from western Europe across northern Asia, and thence throughout North America. They had, of course, passed over at a time when the two continents were united at what is now Bering Strait. When the mammoth, and the animals which were contemporary with it, migrated in this direction, the cave-men who hunted them would naturally go with them. In all probability there was a period when people of this race were scattered over a wide region of the earth extending from western Europe to northern America.

In the discussion which followed, Prof. T. Rupert Jones expressed the opinion that the skeletons found in the caves and other localities where the implements of the cave-dwellers have been discovered belonged to this race; and if so, they were a tall people, of a bodily structure very different from that of the Eskimo. Dr. Wilson remarked that the hostility between the Eskimos and the Indians adjoining them is no greater than that which often exists elsewhere between two tribes of Indians; as, for example, between the Sioux and the Chippewas, where it is always found necessary to keep a wide space of uninhabited land between them. As to the similarity of implements and usages, that is common between barbarous races whose condition and surroundings are similar. The fact that the Eskimos do not bury their dead is readily accounted for by the climate, which would usually make burial impossible. Professor Dawkins, in reply, insisted that there was no evidence that the skeletons mentioned by Professor Jones belonged to the cave-men. He believed them to be intrusive burials. As to the similarity of implements, it must be remembered that in the present case the resemblance extended far beyond a few rude stone or bone tools and weapons, and included the element of artistic faculty and products. The result of the discussion appeared to be, that the paper, while admitted to be highly valuable as a contribution to our knowledge of the subject, left the opinions on the different sides as widely apart as before.

Mr. F. W. Putnam gave a most interesting account of his examination of a group of mounds in Hamilton county, O., made on behalf of the Peabody museum at Cambridge. Discoveries were made which seem to far exceed in interest and importance any thing which has before been learned concerning the builders of these mounds. As this search will be the subject of a much more elaborate paper, which will be read before the American association, a summary of it would be out of place here. All that need be said is that the facts detailed by Mr. Putnam seem to show a more complex social life, more abundant and varied artistic products, and a higher status altogether, than can be deemed consistent with the views of those who hold that these mound-builders were merely the ancestors of our present Indians, and in the same stage of culture.

An important communication by Major Powell, on the classification of American languages, was illustrated by an ethnographic map, comprising the greater part of America north of Mexico, with some vacancies where the affinities of the tribes are considered by him to be not fully determined. The number of distinct linguistic stocks in this region is quite large; and as they have been studied by many investigators, some confusion has arisen from the variety of names given to them. Major Powell proposed to adopt a system of nomenclature based on certain definite rules. One of these rules is to adopt the name given to each stock by the author who had first written about it. He would not, however, go back for this purpose beyond the year 1836, the date of the publication of Gallatin's 'Synopsis of the Indian tribes,' which might be deemed the first scientific work on American ethnology. Another rule would be to discard all double names, that is, all designations formed by the union of two names, such as Huron-Iroquois, or Algonkin-Lenape. Finally, to distinguish the name of a linguistic stock or family from that of a language or dialect included in it, the former or 'stock' designa-

tion should always terminate in '*an*.' Thus we should have Eskimoan, Shoshonean, Algonkian, Iroquoian, Pawneean, and the like, as the names of the different stocks. He was decidedly of the opinion that no mode of classifying the Indian tribes other than by their languages would be found satisfactory. The physical differences are certainly not sufficient. The arts are no criterion, as they are readily adopted by one race from another. Institutions are more permanent; but still in some cases they are adopted, and they do not sufficiently distinguish the races. Mythologies are more distinctive; and, indeed, it will generally be found that tribes speaking languages of one stock have similar mythological beliefs. There are in North America about eighty linguistic stocks, and as many mythologies. The investigation and classification of these stocks and of the languages included in them is an important part of the work which is now engaging the attention of the U. S. ethnological bureau.

In the discussion which followed Major Powell's communication, it was suggested that the establishment of a complete ethnological nomenclature was properly the work of an international commission, such as had been found necessary in geology and in electrical science. It would be a very suitable work for a committee of the anthropological section in the International association for the advancement of science which seems likely to be formed. Professor Max Müller, it was mentioned, had proposed for subfamilies or groups the termination in *ic*, as Indic, Persic, Tataric, Ugric. These and other suggestions could be considered by an international committee, whose conclusions would probably be generally adopted, and thus the confusion and uncertainty of names which now cause much perplexity would be removed. This suggestion was received by the section with indications of general approval.

Mr. C. A. Hirschfelder's paper on anthropological discoveries in Canada gave much very interesting information. His investigations have been quite extensive, including the opening of over three hundred Indian graves and mounds. The large number of Indian wares and relics found in these excavations now form an important part of the collections of the Canadian ethnological museum at Ottawa. A description of the vast Huron ossuaries, or bone-pits, was given, fully corroborating the accounts of the Jesuit missionaries. The earthworks of Canada are much more numerous and important than has been generally supposed. Most of these are considered by Mr. Hirschfelder to be the work of the Hurons and other tribes known to us; but one, of evidently very ancient date and peculiar character, he is inclined to ascribe to the mound-builders of the Ohio valley, or a race akin to them, as it bears a strong resemblance to the works constructed by that people. It is situated on an elevated ridge in the county of Elgin, a short distance north of Lake Erie, and has much the appearance of having been a stronghold in a hostile country. It comprises about eight acres, the dimensions being four hundred and twenty-eight by three hundred and twenty-five feet. A double wall, separated by a ditch twenty feet wide and five feet deep, forms the defence. The outer wall is thirty feet thick, and has on the inside a ledge where a row of men could lie at full length concealed from observation. All the arrangements show that the fortress was intended to have a strong garrison, and to be prepared to meet a large assailing force. The numerous burials and weapons in the vicinity seem evidences of a protracted warfare carried on around it. The antiquity of this singular fort is shown by the size of the trees. The largest of these is over eleven feet in circumference, and must have been nearly four hundred years old. Various indications seem to show that the defenders were finally conquered by overwhelming numbers. A natural conjecture would be, that the mound-builders had planted this outlying fortress in a conquered territory north of Lake Huron, whence they were finally expelled by the native tribes. Mr. Hirschfelder's paper contained much other information of great interest.

A very valuable paper on the Huron-Iroquois as a typical race of American aborigines was read by Dr. Daniel Wilson, evincing the wide research and careful induction characteristic of the writer. The number and extent of the Huron-Iroquois nations were described, with the characteristics which distinguished them from other Indian tribes. The people whom Cartier found at Quebec and Montreal were evidently of this race, and the evidence tended to show that they were of the Huron division of the race. The crania of the Huron-Iroquois people, like those of the northern Indians generally, were long and well developed. The contrast between their skulls and the nearly globular crania of the Ohio mound-builders was striking. The latter people were evidently very numerous and well-organized, though they had not attained an advanced degree of civilization. After examining all the evidence on the subject, the conclusion to which he had been brought was, that the mound-builders were a people of a not very high type, who were under the control of rulers of superior energy, a sort of Brahminical class, by whose direction their remarkable engineering works were constructed.

In a subsequent paper Dr. Wilson described a skull from the loess of Podbaba, near Prague; and one found in alluvium at Kankakee, Ill., along with the tooth of a mastodon. He compared the former with the famous Neanderthal skull, termed pithecoid by Huxley, and showed that there was in certain points a striking resemblance, and yet there was no evidence in the former of deficiency of brain, and probably would not be in the latter if we had the whole of it. The Kankakee skull, though found under circumstances which seem to indicate for it as great antiquity as that of the Neanderthal and Podbaba crania, is a well-formed Indian skull of the usual type. There is, however, no clear evidence that its contiguity to the mastodon's tooth was not the result of accident. It can only be said that they were found near together, and that the discoloration is about the same in both. Dr. Wilson is, however, inclined to believe that the mastodon existed to a later time on this than on the

eastern continent, and not improbably man will be found to be contemporaneous with it.

Major Powell gave an account of the peculiar marriage laws of the American aborigines, prefaced by some general considerations on the motives which had led to the establishment of these laws. These he traced mainly to the desire of preserving peace, which was a marked characteristic of the domestic legislation of the Indians. This was illustrated in their burial customs, in disposing of the effects of the deceased, and in other usages. As one of the main causes of dispute among barbarous tribes is for the possession of women, it was natural that their laws should be specially strict on this point. The manner in which marriages are regulated for this object, and especially the influence of the clan system, were clearly pointed out. As the paper is understood to be a summary of the contents of a large work, which will shortly be published in full, further details need not be added here. The clear and judicious views propounded were highly commended by Dr. Tylor.

An entertaining paper, on the customs and languages of the Iroquois, was read by Mrs. E. A. Smith. The peculiarly descriptive force of the names given by the Iroquois to the animals and other common objects surrounding them was shown by many curious examples. The word for rattlesnake means 'he squirms;' for rabbit, 'two little ears together;' for goose, 'it breaks its voice.' Tears are 'eye-juice;' sugar is 'tree-juice.' This is a mode of word-formation common in other Indian languages. Mrs. Smith affirmed that the missionaries and all other authorities who have heretofore written on the Iroquois languages were mistaken in their views as to the genders and pronouns of these languages, — a hazardous assertion. The conclusions of educated French and English missionaries, who have spent many years among the Indians, and speak their language fluently, can be properly controverted only by one who has given the same amount of time and attention to the study.

An elaborate and extremely interesting paper by Mr. F. H. Cushing, on the development of industrial and ornamental art among the Zuñis of New Mexico, illustrated by many pictorial designs, attracted much attention. It is impossible in the limited space at command to give even a summary of the contents of this valuable communication. An outline of the reasoning is all that can be attempted. Mr. Cushing finds reason to believe that the civilization of the Zuñis is purely indigenous. When they first entered on their existence in the little oases of the desert which they made their home, they were in a very low stage of barbarism; out of which they gradually raised themselves by a slow but steady course of self-development. The stages of this progress were set forth with much ingenuity and clearness. Their residences rose gradually, from the brush-covered wigwam to the small building of lava-stone, either isolated near a spring, or fastened for security to the shelf of a cliff; and thence to the huge, many-storied stone barrack, which is both cliff and dwelling in one. In like manner their earliest vessels of gourds, when incased in wicker-work for the convenience of transportation, gave the first idea of a basket or wicker tray. The basket was lined with clay to retain the food which was boiled in it; and from this custom, the knowledge of pottery took its rise. The first ornamentation of their pottery was derived from the imitation of wicker-work. Afterwards other elements of a pictorial nature came in. The gradual progress of these improvements was traced by Mr. Cushing with a care and minuteness which leave no doubt of the correctness of his theory. We thus learn the interesting truth, that civilization and art, of no mean type, may spring up among a rude people, without external impulse, in a few centuries; for Zuñi culture and art are evidently not many centuries old. The notions which some anthropologists have entertained, that many thousands of years are needed before a savage people can emerge into civilization, — which the Zuñis are just touching. — are dispelled by Mr. Cushing's discoveries. In tracing the course of this progress, good use is made of linguistics, by resorting to the original meaning of the names given by the natives to the various objects under consideration. The name of the object is found, in many cases, to give the clew to its origin.

A remarkable paper on the races of the Jews was received from Dr. A. Neubauer, now residing in England, who was described by the president as one of the most distinguished rabbinical scholars of Europe. Dr. Neubauer's essay aimed to controvert the common idea that the Jews differ from most other nations or races in the special characteristic of their purity from foreign intermixture. So far is this from being the case, that, as was shown by much evidence drawn from the Scriptures and other historical sources, the Jews have always been inclined to foreign marriages. Moreover, the number of proselytes to Judaism from the surrounding races has been very great. Few races, in fact, have undergone more intermixture with other stocks. The physical and moral differences between the communities of Jews in various parts of the world are very great indeed; and these are accounted for partly by their intermarriage with other races, and partly by the influences of their environment. To come to a thoroughly scientific conclusion as to the Jewish physique, about which many erroneous ideas are entertained, careful admeasurements are necessary. Dr. Neubauer suggested that when such admeasurements are made, the right point to begin at would be Jerusalem. The paper made a strong impression, and the president expressed his full concurrence in Dr. Neubauer's views.

An account of the habits and customs of the Innuits or Eskimos of the western shore of North America and of Point Barrow, the extreme north-west portion of the continent, was read by Lieut. P. H. Ray, and contained many facts and conclusions of much interest. He gave his reasons for believing that the Eskimos had occupied the far north of America from a remote period. Among other facts, he mentioned that snow-goggles, such as are used at present, had been dug up twenty-eight feet below the surface of

the ground. The Eskimos are, in his opinion, a people of the ice, and from time immemorial had lived along the ice-border, advancing and retreating with it, but never residing far from it. All their habits of life were formed from this contiguity. He considered them to be a race distinct from the Indians, not merely in language, but also in physical traits and in character. They had brown hair and eyes: a black-eyed Eskimo was hardly ever seen. Their complexion was a clear brown, through which the play of color could be plainly observed. They were naturally a peaceful people, and he had never known a quarrel among them. Though very superstitious, they could not be properly said to have any religion. They had no conception of a future existence. They did not bury their dead, because the climate made this usually impossible. They merely conveyed the corpse to a distance from the village, and left it to be devoured by the dogs. That, they said, was the end of the man. Still they had ideas about a superior being who had created man and other animals; and they also believed in an evil spirit, who was to be propitiated, or rather menaced, into compliance with their desires.

A paper on the nature and origin of wampum, by Mr. H. Hale, described this article as shell-money, differing from the East Indian cowries as coined money differs from bullion. It consists of circular disks or cylinders, made from various kinds of sea-shells, polished to smoothness, and strung upon strings. These served as currency among the North-American Indians, and for a time among the colonists. Strings and belts of wampum were also much employed in the ceremonial usages of the Indians, and as mnemonic records. The use of this money was traced across the continent to California; thence to the Micronesian groups in the North Pacific, where it is universal; and thence to China, where in early times, according to the native authorities, the money was made of tortoise-shell disks or slips strung on strings. The modern Chinese copper money, known to Europeans as 'cash,' is made in imitation of this tortoise-shell currency, and is strung in like manner. It is also much used in ceremonial observances, like the American wampum. The mode in which the use of this form of money may have spread from Eastern Asia to America is shown by the fact that several Japanese junks have been wrecked on the west coast of this continent during the present century, and their crews have been rescued by the Indians. The Micronesians have also large sailing-vessels, in which they frequently make long voyages, and are often driven by storms to great distances out of their course. From one or other of these sources the Californian Indians may have easily learned such a simple art as that of making and using shell beads for money; and this art was one likely to spread to the other tribes among whom it was found.

In the long and interesting discussion which ensued, the views proposed in the paper were generally approved. Professor Boyd Dawkins suggested for consideration the question whether all money might not have originated in the exchange of ornament. A doubt having been expressed, whether the shell-money was among the Indians a real currency, that is, 'a measure of value,' several facts and authorities were cited on that point. Mr. Cushing stated that it was a currency among the Zuñis, and had a definite value. Dr. Tylor mentioned the decisive fact, that among the Melanesians, who nearly adjoin the people of Micronesia, the shell-money is in use, and is employed in true banker fashion. A native who lends nine strings of this money expects to receive back ten strings from the borrower at the end of a month. To gain this interest, it must be used in common as a medium of exchange, which it could not be if it were not a measure of value.

Some other valuable papers were read; and this, the first session of section H, must be deemed to have been a particularly satisfactory one.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PROCEEDINGS OF THE SECTION OF CHEMISTRY.

DR. SPRINGER of Cincinnati exhibited and described some improvements in torsion scales and balances. These instruments are constructed with steel bands or wires, upon the twisting or torsion of which they depend for their action. Professor Caldwell inquired whether balances for chemists were made upon this principle, and their cost compared with ordinary knife-edge balances. Dr. Springer said that the very first one made was sent to Prof. F. W. Clarke at Cincinnati, and used by him for chemical analysis. Professor Clarke said that its use by him was very satisfactory. The adjustments were not easily disturbed, which was a very important matter; and it was as sensitive as a good knife-edge balance.

A paper on the chemistry of roller-milling was read by Mr. Clifford Richardson. The author stated that with ordinary milling the north-western hard winter wheat gave a dark-colored flour. This difficulty is entirely overcome by using steel or porcelain rolls run at different speeds. The results of a large number of analyses of the products of roller-milling were presented in a series of tables. The ash, oil, fibre, and albuminoids increase towards the outside of the grain. In true bran there is no gluten, the gluten cells being scattered through the interior of the grain. All the experiments were made on hard Minnesota spring wheat. Eastern wheat does not work well with roller-milling, the flour being dark-colored.

Dr. A. A. Julien read the report of progress by the committee on indexes of the literature of chemical

elements, appointed in 1882. There have been completed up to the present time, Ozone, by Professor Leeds; Peroxide of hydrogen, by the same author; The speed of chemical action, by Professor Warder; Glucose, by Dr. E. J. Hallock; The action of heat on metallic salts, by Professor Prescott; and about six others are in progress. The co-operation of the Smithsonian institution had been solicited by the committees, in order to reach foreign chemists. The section unanimously indorsed the action of the committee in the steps already taken.

Prof. C. E. Munroe read a paper on examination of the methods proposed for rendering the lighter petroleum oils inexplosive. The author used alum and ammonic chloride, and found they were both insoluble in the oil, and inactive. Camphor also was used; and this reduced the flash-test, but made a more explosive mixture with air than the vapor of the original oil.

Professor Atwater read a paper on the chemistry of fish. Flounder is the least nutritive of fishes; while the salmon, when fat, is the most nutritive. Oysters have least nutritive matter among the invertebrates; and northern oysters are more nutritive than those from the south. The flesh of fish contains less fat and more water than that of vertebrates. Digestive ferments act upon the flesh of fish in the same way as upon that of the vertebrates, about ninety-eight per cent of the albuminoids being digested in both cases. As ordinarily found, fish gives from five to twenty per cent of edible matter. A member of the British association asked if the integument of the fishes had been examined. Professor Atwater replied that he had confined his attention to the muscular tissues.

Prof. F. P. Dunnington exhibited and described a new form of gas regulator, depending upon the expansion and contraction of a confined portion of air acting upon a column of mercury.

Professor Stewart made some remarks upon a new process of manufacturing leather, by which the depilitated hides are treated with sulphurous-acid gas in closed vessels, the process being completed in about twelve hours, producing a soft pliable leather.

A discussion on valence was opened by Prof. F. W. Clarke. He remarked that it was especially useful in organic chemistry in explaining isomerism and in synthesis. It was also useful in mineralogy; and he mentioned as examples of isomerism the three minerals kyanite, andalusite, and fibrolite, giving a structural formula for each. He then took up the questions of variable valence, invariable valence, and maximum valence, as points that might be discussed. He remarked, further, that valence was an attempt to explain the arrangement of the atoms in a molecule; and spoke of the drawback of being obliged to represent them on a plane surface, space of three dimensions being much nearer the true state of affairs. Prof. B. Silliman remarked that the last statement of Professor Clarke was the key to the whole difficulty about valence. A plane surface is insufficient to explain the facts. He testified to the great utility of valence, and spoke of the chaotic condition of organic chemistry before this question of valence was appreciated. It was a working hypothesis, a scaffold about a building, but not the building. Hypothesis is not always the truth. Prof. W. Ramsey, of the British association, said that the difficulties about valence could be traced to Lavoisier, who worked upon stable compounds as oxides and chlorides. He also thought that a study of the heat of formation of many compounds would be a key to the valence of the elements; and said that the difficulties of conceiving of the motions of the atoms were well illustrated in Sir William Thomson's effort to explain them in complicated vortex evolutions. Mr. A. H. Allen, of the British association, called attention to the failure of chemists to recognize the value of the work of John Newlands, in the periodic classification of the elements usually ascribed to Mendeljeff. Professor Greene remarked that it was best to consider the cause of valence. Professor Ira Remsen testified to the utility of valence. He remarked that there were two ways of teaching: one by giving all the principal theories first, and the other giving the facts and then the theories, — which latter he considered the best method. He had come to the conclusion that valence should never be mentioned until all the important properties of a compound are known. In regard to its value to young students, he thought its use was dangerous until they fully understood its meaning. He believed that the value of valence had been magnified, and that it was better to study the reactions of compounds, and the methods for their synthesis, and the manner of breaking up. Mr. A. H. Allen, of the British association, said that many formulae that showed the structure of compounds according to the valence of the elements do not give any idea of the true constitution of these compounds as ascertained from a knowledge of their properties. He gave, as examples of his meaning, potassic dichromate and fuming sulphuric acid. Professor Dewar, of the Royal institution, London, maintained that the graphical method and structural formulae were most useful, but they are often presented in a way that shows an incomplete knowledge of the ideas of the person who devised the formula. He remarked that the text-books contained too many pictures of graphical formulae, and that he considered it better to follow the historical method for developing theory. Professor Atwater thought that some idea of valence should be given at the beginning, as it assisted the student's memory. Prof. W. Ramsey, of the British association, said that he was satisfied of the utility of making the student perform experiments that brought out facts to illustrate the theory of valence, and thus understand its meaning from his own work. Professor Caldwell said that he could not get along with students in chemical analysis who had not obtained some idea of the theory of valence. Professor Remsen thought that the theory of valence might do some good as an assistance to the memory; but such assistance was of doubtful value, and too empirical. Prof. J. W. Langley, vice-president, said that valence, or chemism, may be a force emanating from the atom, or it may be a force outside the atom; it is static, or

dynamic, and a knowledge of it was more a physical than a chemical problem. From the educational view he thought it better to use the theory of valence in connection with the history of the theories concerning atoms and molecules. As a farther step the language and figures of magnetism might be used.

The paper on the optical methods of estimating sugar in milk, by Dr. H. W. Wiley, showed the great importance which must be attached to the influence of albumen on the specific rotary power of milk-sugar. The author prefers to use an acid solution of mercuric nitrate in precipitating albumen, for an excess fails to dissolve the precipitate. Professor Jenkins finds, that on adding sulphate of copper and the potassic hydrate the separation of albumen is very complete.

A discussion on the educational methods in laboratory practice and in the illustration of chemical lectures was opened by Professor Remsen, who remarked that in Germany the student does not go into the laboratory until he understands re-actions, while in England and the United States he is placed there at the beginning of the course. Professor Remsen follows an order of instruction in which the student first becomes acquainted with apparatus and methods of manipulation. He next makes gases, and repeats lecture experiments. He then experiments on oxidation and reduction. Next follows the quantitative analysis of air. Then come alkilimetry and acidimetry, with success. This practical work and the lectures occur simultaneously, and by the time the lecturer has reached the metallic elements the students are ready to take up test-tube re-actions with profit. During the first year the student should only just begin analysis. After the general properties of the metals are known, let the student devise methods of separation. The course of instruction in our colleges, Professor Remsen regards as too short, and superficial. Lecture-experiments should never be made for show. Aesthetics and chemistry are entirely distinct. Professor Atwater said that chemistry is taught now, as a rule, after the student has acquired the methods of the classics and has never been taught to observe facts. Chemists must show that their science will give what is called 'liberal culture,' or it will not find a place in our educational institutions. Present methods are not doing this, as they fail to make the student think for himself.

Prof. W. O. Atwater read a paper on the assimilation of atmospheric nitrogen by plants. Experiments were made on pease grown in washed sea-sand, supplied with proper nutritive solutions. The pease acquired from thirty-eight to fifty per cent more nitrogen than they contained originally, and than had been supplied as nutriment. The above result, Professor Langley remarked, is important, as it is contrary to generally received ideas.

Dr. Springer next read a paper on fermentation without combined nitrogen, in which he showed that the ferment found on the stems of tobacco-plants, and which decomposes nitrates, on being applied to starch and sugar gives rise to butyric acid, and appears to prove that we can have life without protoplasm. After a discussion upon fermentation, a motion was carried that a committee of the section should petition Congress to afford facilities for the study of fermentation. Dr. Springer, Professor Wiley, Mr. Clifford Richardson, Professor Remsen, and Professor Clarke constitute this committee.

Professor Dewar of the Royal institution read a paper on the density of solid carbonic acid. The solid acid was obtained by compressing carbonic acid snow by a hydraulic press. The specific gravity was found to be from 1.58 to 1.60 of the solid acid. Some little discussion resulted, by which it was brought out that the curves obtained from a study of the critical points of gases may explain some facts in regard to dissociation, as there are many cases where the theory of dissociation and experiment do not agree. The pressure necessary to produce the solid carbonic acid is about one and a half tons.

Professor Munroe described some experiments which tended toward the establishing of a law of deliquescence. The temperature and shape of the vessel were not taken into account.

The composition of human milk, by Prof. A. R. Leeds, was found, on using every precaution, to be: albuminoids varying from .5 to 4.25 per cent, lactose from 4.1 to 7.8 per cent, and the fat from 1.7 to 7.6 per cent. The appearance and specific gravity of the milk never indicated its composition. Improvements in apparatus for rapid gas analysis by Dr. Arthur H. Elliott consisted in reducing the length of the tubes by enlarging the upper portion of them into bulbs, and in substituting a solution of bromine in potassic bromide for the liquid element to absorb illuminants. Mr. A. H. Allen, in his communication on oils, said that shark and fish oils are often unsaponifiable, and hence are not fatty ethers. He believes them to contain cholesterine, like cod-liver oil. The fixed oils can be separated into groups, but we know no process for separating a mixture of lard and cotton-seed oil.

These communications closed the sessions of by far the most successful meeting of section C for many years.

PROCEEDINGS OF THE SECTION OF MECHANICAL SCIENCE.

Owing to previous unfavorable conditions, this was practically the first meeting of the new section (D) of mechanical science. Notwithstanding the great heat, the small and inconvenient auditorium, and the fact that the electrical exhibition deprived the section of much local support, the meeting was a greater success than had been expected, and warrants the anticipation that this will shortly become one of the leading sections of the association as it is in the British association. The attendance was large, and included many prominent English visitors, who furnished papers, and took part in the discussions. In order to indicate more definitely the scope of the section, it has been proposed to extend its title to 'mechanical science and engineering;' and it is hoped that our leading engineers and architects will give it their active support by presenting before it papers embody-

ing the progress of their work from scientific standpoints. Besides appointing a committee of invitation to increase the interest and attendance for the next meeting, two special committees were appointed to work up the subjects, 'The best method of teaching mechanical engineering,' and 'The use and value of accurate standards, screws, surfaces, gauges, etc., and of systematic drawings, in the modern machine-shop.'

On Friday, Mr. J. C. Hoadley read by request his excellent *résumé* of steam-engine practice in the United States; reviewing the different classes of engines, and giving figures to show their economy, with other important facts. Mr. Hoadley classifies engines as follows: large compound engines for pumping, etc., rolling-mill engines, saw-mill engines, marine engines, locomotives, hoisting-engines, steam-cranes, steam-pumps, portable engines, etc., and engines for electric lighting. This would seem to be an enumeration, rather than a classification, of different types of engines. The paper contains, in compact form, information as to all the prominent engines, and forms a valuable addition to steam-engine literature. It will be printed in full in the Transactions.

The subject for the day was then introduced by a paper on the training for mechanical engineers, by Prof. G. I. Alden of Worcester, Mass., in which one phase of the subject was presented. Professor Alden urged the importance of practical as well as scientific attainments, and claimed that the shop for manual instruction should not be such an institution as would be developed by or out of the school, but should bring with it not only the methods but the business of an actual productive machine-shop, the work being done for the market. It is to be regretted that other prominent gentlemen expected to furnish papers were prevented from attending.

The discussion commenced with so much interest, that an extra session was devoted to it, when the various phases of the question were brought out. A starting-point was thus formed which should enable the committee to secure a more complete, important, and decisive discussion next year. Messrs. Rigg, Kent, etc., and Professors Woodward, Robinson, Wood, Thompson, Higgins, Carr, etc., and Webb, joined in the discussion; and the latter called attention to the necessity of distinguishing between machine-shop practice and experiments in the mechanical laboratory, and pointed out three existing and natural kinds of schools: 1°. manual training schools, where the manual exercises are for discipline only; 2°. schools for master-machinists, superintendents, etc., as at Châlons-sur-Marne, where the course is seven hours daily, for three years, in the shop, with such instruction in mathematics, draughting, etc., as can be added thereto; 3°. schools for mechanical engineers (as the École centrale), where theoretical training predominates, and where there is either no shop-practice, or only such as is specialized and organized so as to give, in the limited time available, the maximum intellectual and manual grasp of machine-shop methods.

On Monday Prof. W. A. Rogers read a paper on a new method of producing screws of standard length and uniform pitch; and Mr. J. A. Brashear, a paper on the production of optical surfaces: the subject for the day being the value of accurate screws, surfaces, etc., in the machine-shop. Professor Rogers has developed a method by which practically perfect screws can be cheaply made, and Mr. Brashear has succeeded in making perfectly flat surfaces of larger size than usual. Professor Rogers's method of making a screw presupposes a correctly graduated scale over which a microscope attached to the lathe-carriage moves. The error in the movement of the carriage is thus made visible, and can be neutralized by means of a stout micrometer screw, which varies slightly the position of the cutting-tool on the carriage. By this means the screw is cut so nearly true that the remaining inequalities are easily ground out by means of a long nut cut into four pieces, which can be put together in different ways so as to make the errors in the nut oppose those of the screw. Professor Rogers pointed out the way for further improvements, and hoped that some way would be found for the detection of errors extending over long distances, by means of gratings ruled by the screw. The subject of the proper use and preservation of such perfect screws in the machine-shop was also touched upon by Mr. Pickering, who has found means in his own practice of distributing the work as equally as possible over the whole leading screw of a lathe in order to keep it from wearing unequally. This whole subject will come up next year for discussion, and the paper was deemed of such importance as to warrant its publication in full in the Transactions. Mr. Brashear's paper is also to appear in full. The discussion of these papers, engaged in by many prominent physicists and engineers, was highly interesting. It opened by a criticism from one of our English friends, who expected to find every thing in the United States done by machinery, and was disappointed to find that these flat surfaces (or slightly curved, when needed so for lenses, etc.) were produced by polishing, much in the old manner; and it was claimed that the correct form should first be produced by machinery, and the polish put on subsequently. The telescope of Mr. Bessemer was alluded to as an instance where such work would be done by machinery. Several gentlemen followed, and spoke of the difference between ordinary work which might thus be produced, and the extremely accurate forms required for astronomical purposes produced by Mr. Bessemer. Professor Harkness described his measurements of the 'transit of Venus' plane mirrors down to hundred-thousandths of an inch, and showed that work was done in the United States to a degree of accuracy not perhaps appreciated in Europe. Mr. Brashear closed the discussion by a complete defence of his methods. He claimed that the degree of accuracy of his work was such, that, after a surface was polished, he could, by a few suitably lengthened strokes of the polisher, make it parabolic, elliptic, or any thing he wished, and that his principal difficulty was that the finest polishing powders cut too fast, so that to shape first and polish afterward was meaningless: then, growing eloquent, he ventured, for reasons which he explained, to predict that Mr.

Bessemer's telescope never would be completed in the intended manner, and this opinion was evidently shared by many gentlemen present.

On Tuesday Sir Frederick Bramwell explained the method employed to warm the Third Middlesex-county lunatic-asylum at Banstead, Eng., where a circulation of warm water is produced by centrifugal pumps, which maintain two parallel mains in a relatively plus and minus condition. The discussion was a comparison of warm water and steam for heating purposes; and the former was shown to have various advantages over steam, where the expense of the plant is not considered.

Mr. J. C. Hoadley's paper on driven wells followed, and was a description of a series of experiments to determine the way in which water moves toward a well from which it is pumped. Driven were shown to obey the same law as open wells; which is, that the water simply runs down hill, toward the well, its flow being more or less obstructed by its percolation through the soil, so that its surface forms a slope more or less steep, i.e., an 'obstructed hydraulic slope.' This is only what was to have been expected, but it is interesting to have it proved experimentally. In the discussion, a fresh-water well was instanced, bored on the sea-beach, in which the water rose and fell with the tide; the weight of the latter depressing the underlying and separating strata.

Mr. W. A. Traill not being present, Dr. Fitzgerald of Trinity college, Dublin, described the Giants' Causeway and Portrush electric tramway. A working model of the same is to be placed in the electrical exhibition. Water-power is used for this line, which is six miles long, the American turbine used being a mile beyond the end; so that the maximum distance over which the electricity is carried is seven miles. The rails carry only the return current; there being a third rail, on two-feet-high posts at the side of the track, for the direct current. Two springs rub along on this rail to connect it with the dynamo in the car: these being placed as far apart as possible, an opening less than their distance apart can be passed without breaking the current. The railway, however, runs along a cliff by the sea, so that there are but few openings. The road, though new, is represented as a complete success. The line is quite hilly, the maximum incline being one in twenty-eight; crossing-places are all arranged on an incline, so that the car running down can give up the third rail to the other, and go on by gravity. The electrical arrangements were planned by William Siemens, his death occurring just as he had seen the whole thing in successful operation. It is interesting to note, that the current itself has been used to telegraph to the next car, ordering it to stop. The current is governed by a man in charge of the turbine, who regulates the water to the work: this reminds us of the suggestion of Professor Thompson at the Montreal meeting, that the fireman should be able to completely regulate an electric-light plant by his firing. Running expenses by horse-power, steam-power, and by the turbines, are found to be in the proportion 10:7:3; so that, where water-power can be obtained, an immense saving can be effected by the arrangements here used. Dr. Preece followed, and described Mr. Holroyd Smith's improvements in electric railways. Mr. Smith employs much the same arrangement as on our cable lines, using, however, in place of the cable, a pair of fixed electrical conductors, between which runs a shuttle; the current is taken off by it, and brought up to the car through the groove, thus placing the electric conductors under ground, as they evidently should be. Other minor details were described, otherwise the line is essentially the same as that previously described.

Mr. A. Stirling then followed with a paper in which the economy of the electric light was made the subject of calculations based on the author's experience. It was stated, that at present, for lighting a compact block, the incandescent light could be considered as no more expensive than gas at \$1.69 per thousand. Mr. Preece opened the discussion by a criticism on the theoretical character of the calculations given, claiming that no dependence could be placed on such statements, and went on to give his own experience, which, however, appeared to fairly sustain Mr. Stirling's figures. He stated that he had experimentally lighted three miles of streets in London (Wimbledon), and that it was not a success; the turning-point seeming to be the price of gas, \$2.25 in New-York city, but only one-third that price in London. Mr. Preece described his own establishment, where, by means of a gas-engine in the garden, the house is lighted in the most convenient fashion (including a doll's house of four rooms). He stated also, that the same quantity of gas gave more light when thus indirectly used, than could be got from it by burning it in the best gas-burners: this is readily to be believed, the gas furnished by gas-companies being much better adapted for producing heat than light. It is to be hoped that the time will soon come when the present gas mains and pipes will be employed to distribute gas for heating-purposes alone. Instances were given where the amount manufactured had been increased, or the quality of the goods improved, over ten per cent, by the introduction of electric lighting. Mr. Preece explained the superiority of this light, by saying that while in the arc light a candle-power was obtained by the expenditure of but one watt of energy, or by the incandescent light two and a half watts, gas required the equivalent of sixty-two, and candles of ninety-seven watts, for every candle-power produced. The great stumbling-block in universal electric lighting was shown to be the enormous cost of the mains for conveying the electricity over long distances. At the afternoon session, Mr. Crampton exhibited a piece recently cut out in repairing the first submarine cable ever constructed, and which he laid under the English Channel over thirty years ago. The model was then sent to the historical collection of the electrical exhibition as a donation to the Franklin institute. Mr. J. Dillon read two papers describing his method of regulating floods and an automatic method of sounding the bottoms of shallow rivers. The first depends on

sluices which are automatically opened and shut by large floats; and the second consists principally of an arm dragging along on the bottom, and taking various angles according to the depth of the river. Prof. J. B. Johnson's paper on Three problems in river physics was devoted to a discussion of the transportation of sediment, and the formation and removal of sandbars; the flow of water in natural channels; and the relation of levees to great floods, and to the low-water navigation of rivers. Sediment was distinguished as either continuously or discontinuously in suspension, or as rolled along the bottom; and the action of the second sort in the formation of bars was discussed. It was also shown, that the third kind produces sand-reefs on the bottom which move along perhaps ten to thirty feet per day: they are sometimes fifteen feet high, and succeed each other at intervals of some three hundred feet. For the flow of water, the old formulae were shown to be worthless; but the author did not make the mistake of giving new ones. Levees were discussed, and their use discountenanced; waste weirs into side outlets being recommended. This paper will be printed in full. Mr. O. Smith's paper on topography of machines referred to more exact and systematic methods in drawing and speaking of machines and parts thereof, and should have been discussed on Monday. On Thursday, Mr. Arthur Rigg discussed the advantages of trip and eccentric gears, and a somewhat lengthy discussion ensued. It appeared that the American practice of employing simple valve-gearing in small quick-speed engines was approved of, though giving a somewhat inferior card to that of a trip-gear engine. Three other papers — 'The strength of cast iron,' W. J. Millar; 'Experiments on belting,' G. Lanza; 'Steam-engine tests,' C. H. Peabody — were, in the absence of the authors, presented by Professors Wood and Webb; and the session concluded with an interesting talk by vice-president R. H. Thurston, on the development of the philosophy of heat-engines.

PROCEEDINGS OF THE SECTION OF GEOLOGY AND GEOGRAPHY.

It will be readily admitted by all who were in attendance upon any of its proceedings, that the sessions of section E of the Philadelphia meeting of the American association possessed, both as regards the numbers present and the character of the papers presented, a very unusual interest. As a special feature, might perhaps be mentioned the large amount of attention devoted to those most difficult of geological problems relating to prefossiliferous strata and the origin of the crystalline schists, — questions which not only in the meetings of the association, but in the world generally, seem year by year to be claiming an ever-increasing share of geologists' thought and study.

This tendency was well marked by the opening address of the vice-president of the section, Prof. N. H. Winchell, on the crystalline rocks of the northwest, a paper which needs no notice here, as we have already printed an abstract, and which according to the usages of the section admitted of no discussion.

The real business of the section was commenced on Friday morning, the day succeeding its organization, by the reading of a paper, by Prof. S. G. Williams of Cornell university, on the gypsum deposits of Cayuga county, N.Y. He maintained, on paleontological evidence, that these beds were members of the lower Helderberg formation, instead of belonging, as might have been expected, to the Salina period. A section illustrating their occurrence was discussed, and four distinct reasons given for considering their origin to be due to the action of sulphur-springs on beds of impure limestone.

A paper by Prof. E. Orton of Columbus followed, in which he showed how the remarkable symmetry and order pervading the lower coal measures in western Pennsylvania and Ohio extend across the Ohio River into Kentucky. Sections in both Pennsylvania and Ohio were carefully analyzed, and especial stress laid upon the importance of certain thin limestone beds accompanying the coal measures as reliable geological guides. Credit was given to Professor Crandall for having first shown that the sequence of beds was the same on the Kentucky side of the Ohio River as it was in Ohio. An interesting discussion followed this paper, between Professors Lesley and Orton; the former affirming that no traces can now be found of what were the shores of the original coal basin, and that no elevations or depressions accompanied the deposits of coal-seams, while the latter maintained that the evidences of the old shore-line, especially in Ohio, were very manifest.

Prof. F. D. Chester read an account of the geological survey of the state of Delaware, upon which he has for some time been engaged. He exhibited an unpublished map defining the small areas occupied by Laurentian and Cambro-silurian rocks in the northern part of the state; but naturally devoted most of his attention to the more important clays, sands, and marls, which represent the cretaceous, tertiary, and quaternary formations.

The vice-president of the section, Professor Winchell, followed with a description of a salt-well situated at Humboldt, Minn. The brine, although now to be found principally in rocks of Devonian or Silurian age, he considers to have originated in overlying strata, probably carboniferous.

Professor Orton, in a paper on the distribution of petroleum and inflammable gas in Ohio, showed that while scarcely a formation in the whole state was altogether free from them, their presence in really valuable quantities was confined to the subcarboniferous, and even here to two members of this series, — the Waverly conglomerate and Berea grit. These strata alone satisfy the necessary conditions of productive 'oil sands,' i.e., porous layers of sandstone or conglomerate sealed up between impervious layers of shale. As closely connected with the petroleum deposits of Ohio were mentioned the salt-wells, which yield an abundance of brine derived from the same 'oil sands.' This brine is remarkable for the amount of bromine it contains, the production here — one

[illegible] He moreover observed the constant [illegible] of pyroxene to be arranged in [illegible] alternating with [illegible] or apatite, as well as [illegible] evidence that pyroxene passed by [illegible] serpentine, a process which could be [illegible] of the localities visited. From these data it was assumed that siliceous waters, [illegible] limestones originally evenly dolomitic, would cause the [illegible] development of pyroxene by the [illegible] magnesium carbonate into the cor[illegible] Were it the case, as so often [illegible] this pyroxene was developed in layers, [illegible] alteration to serpentine or loganite [illegible] for all the appearances exhib[illegible] without the necessity of appeal[illegible] agencies.

The [illegible] afternoon session of the section was [illegible] devoted to geographical papers [illegible] These had hitherto scarcely re[illegible] the share of attention; but now proved, [illegible] presence of several distinguished mem[illegible] British association, of unusual interest. [illegible] was called to the chair, while [illegible] Pim, R.N., presented a paper on the [illegible] advantages of the Nic[illegible] across Central America. Capt. Pim is [illegible] to speak upon this subject, on ac[illegible] experience and the much careful study [illegible] to the different plans which [illegible] proposed for inter-oceanic communication. [illegible] surveyed under his direction, [illegible] and 1867, across Nicaragua, [illegible] a canal could be constructed at [illegible] expense, for the transference of [illegible] drawing only from four [illegible] The principal objection to [illegible] across Panama was not, he [illegible] difficulties of construction, — [illegible] very great, — but the almost con[illegible] calms prevailing on the [illegible] He himself had once been becalmed [illegible] This paper elicited numer[illegible] remarks from various members of [illegible] them a somewhat extended com[illegible] Rear-admiral Ammen, who had served [illegible] commission appointed by the [illegible] to inquire into the relative merits [illegible] proposed for securing a passage [illegible] Central America.

[illegible] the second geological survey of [illegible] proceeded to give a brief account [illegible] accomplished during the past ten years, [illegible] survey's existence, as well as of its [illegible] He was succeeded by Mr. [illegible] Saunders of London, who has been so [illegible] the recent survey of Palestine [illegible] of the Palestine exploration fund. [illegible] an account of a remarkable [illegible] unknown portion of Tibet, [illegible] frontiers of India and China, by [illegible] surveyor trained under the trigo[illegible] of India. This was only accom[illegible] four years of unparalleled hardship, but has made most important additions to the geographical knowledge of Asia. Mr. Saunders's second paper related to the geography of Palestine, in connection with which the great map of the survey was exhibited. Several exceedingly interesting points were explained, where the geographical researches had succeeded in definitely locating sites of biblical events, as well as shed much light upon many heretofore doubtful and difficult allusions in the sacred writings.

The proceedings of Wednesday were introduced by an extended biographical notice of the late Professor Arnold Guyot, by his assistant, Mr. William Libbey, jun., of Princeton. Mr. Libbey's paper will appear in full in the Journal of the American geographical society of New York. Mr. William M. Davis of Cambridge gave some valuable hints as to geographic classification, based upon the study of plains, plateaus, and their derivatives. He traced the history of an area undergoing gradual elevation through a regular course of development, likening it to the successive phases in the life of an organism. His remarks, which laid special stress upon the educational value of such studies, were admirably illustrated by a series of paper models showing different stages of development in the history of a plateau.

Professor H. Carvill Lewis of Philadelphia described a narrow trap dyke, which he had succeeded in tracing continuously across south-eastern Pennsylvania for upwards of ninety miles through Bucks, Montgomery, Delaware, and Chester counties. The dyke, which is generally only visible as a line of bowlders, has been apparently faulted in several places; one great fault of several thousand feet upthrow being coincident with a large lateral displacement of both trap and the adjoining strata. Another important fault in the triassic formation was also mentioned, whereby the entire thickness of this formation is exhibited. The trap dyke is distinct lithologically from other dykes, and does not mark a fault, although passing through the Laurentian, Cambrian and Triassic formations.

Professor Persifor Fraser, from a study of a point in the archean-paleozoic contact-line in south-eastern Pennsylvania near Gulf Mills, concluded that the hydro-mica schists which outcrop there were older than the accompanying limestones, and hence not to be considered as metamorphosed Silurian strata. Professor Carvill Lewis could not agree with these conclusions regarding the structure of this locality; although Professor James Geikie of Scotland, who had recently visited the spot in company with Professor Fraser, expressed himself as entirely convinced of the correctness of the latter's views.

Papers relating to glacial phenomena, which had been so abundant at the Minneapolis meeting, were but scantily represented in Philadelphia. Mr. J. C. Smock spoke of the remains of local glaciers recently examined by him in the Catskill Mountains; and Prof. J. C. Chamberlain, in presenting a paper by Mr. J. E. Todd, exhibited upon a large map the course of the moraines along the upper Missouri River, and explained the effects which these had produced upon the drainage of the region.

Owing to the intense heat which had prevailed throughout the entire meeting, there was but a comparatively small attendance upon the final session of section E on Thursday morning. A large proportion of those down on the programme for papers had already left town; and almost the only communications of real interest which appeared were those of Professors Julien and Bolton, regarding the results of their examination of various sands. Starting some time since with a study of the so-called 'musical sands' occurring on the Manchester beach, they have been gradually led to extend their researches to sonorous sands from many other localities, both American and foreign; and finally to include within them a study of all ocean, lake, and river sands, whether sonorous or not. So far from being rarities, as they were considered some years ago, sonorous beach-sands are found to have an exceedingly wide distribution. Already seventy-four American and thirteen foreign localities are known, and the number is constantly increasing. The loudest sound may be produced by suddenly bringing together two divided portions of the sand enclosed in a bag. When suddenly compressed between the hands, musical notes are emitted, the pitch rising as the quantity is diminished. The conditions of sonorousness, Professor Julien considers to be perfect dryness, uniformity of grain ranging from 0.3 to 0.5 mm. in diameter, and freedom from dust. Any sand satisfying these conditions, no matter what be its nature, he thinks may be musical. Sonorous sands, when wet, generally become quicksands. The microscopic study of a large number of sands of all kinds showed that a great variety of minerals participated in their composition. No such thing as a pure quartz sand was discovered.

In place of the regular session Thursday afternoon, the section was treated to an excursion over the Reading railroad, under the guidance of Professor H. Carvill Lewis. Various points where different formations occur were visited, and the complications of the local geology about Philadelphia were explained as far as understood.

NOTES AND NEWS.

THE semi-annual scientific session of the National academy of sciences will be held in the court-house, Newport, R.I., Oct. 14, 1884, at 11 o'clock, A.M.

— An interesting study of the bed of the Delaware River has just been published by the U. S. coast-survey. It is the report of Henry Mitchell on the methods which have been followed, and the results which have been reached, in recent surveys of what is termed 'the estuary of the Delaware,' from Philadelphia to a point fifty-two miles below. He uses the term 'estuary;' because farther down the stream, there is a submerged delta, with numerous channels, 'not unlike the passes of the Mississippi, or more like those of the Ganges after its issue upon the Bay of Bengal.' The laborious character of this survey may be understood by the statement that seven hundred and thirty-four cross-sections have been measured, with widths varying from one to five miles, and including many thousand soundings. Professor Mitchell speaks in terms of high praise of the skill with which this work was performed by Mr. J. A. Sullivan of the coast-survey. The point of greatest physical importance is that of the mean depth of the estuary, the bed of which varies so little that the generalized result is best expressed by a horizontal straight line. The fluctuations are chiefly due to inequalities in the nature of the soil. The grand mean of all the soundings is 18.64 feet. The brief report of Mr. Mitchell includes many interesting comments upon the formation of an estuary, to which we can only make this brief allusion.

— Besides those whose names we previously published, the following gentlemen signed the request to the British and American associations, to consider the formation of an international congress. The list is striking as revealing the great extent of the interest felt in the undertaking. The names referred to are: George J. Brush, James D. Dana, James Hall, J. E. Hilgard, J. S. Newberry, Charles A. Young, Charles E. Bessey, William J. Beal, Edward S. Morse, William A. Rogers, Robert H. Thurston, John Trowbridge, J. Burkitt Webb, N. H. Winchell, De Volson Wood, Charles C. Abbott, William Ashburner, W. O. Atwater, N. L. Britton, Robert Brown, jun., W. H. Chandler, Alvan G. Clarke, E. W. Claypole, Joseph Cummings, George Davidson, A. E. Dolbear, Louis Elsberg, S. F. Emmons, J. Fletcher, S. A. Forbes, Simon H. Gage, James T. Gardiner, S. A. Goldschmidt, William H. Greene, Horatio Hale, William B. Hazen, Angelo Heilprin, S. W. Holman, Horace C. Hovey, Alexis A. Julien, Joseph Leconte, J. Loudon, N. T. Lupton, George McCloskie, B. Pickman Mann, H. N. Martin, Alfred M. Mayer, T. C. Mendenhall, William H. Niles, James Edward Oliver, Edward Orton, Richard Owen, A. S. Packard, D. P. Penhallow, W. H. Pickering, William H. Pike, Edmund Baynes Reed, Ira Remsen, John D. Runkle, I. C. Russell, William Saunders, B. Silliman, Eugene A. Smith, Francis H. Smith, Q. C. Smith, M. B. Snyder, Ormond Stone, W. Hudson Stephens, Albert H. Tuttle, Warren Upham, Lester F. Ward, M. E. Wadsworth, Charles D. Walcott, Leonard Waldo, Robert B. Warder, Sereno Watson, Charles Whittlesey, Burt G. Wilder, Alexander Winchell, Henry S. Williams, Jacob L. Wortman, Arthur W. Wright, E. L. Youmans, Joseph Zentmayer.

— Dr. Edward Channing received in 1883 the Toppan prize of Harvard university, and the essay which won this distinction has just been printed as one of the Johns Hopkins university studies in history. The theme was the town and county government in the English colonies of North America. The author is led to compare the Massachusetts system of local government with that of Virginia, and to show that both are survivals of the English common-law parish of 1600. The essay concludes with a tabulated statement of local government in England, Massachusetts, and Virginia; by glancing at which, the reader may

quickly comprehend the diversity of usage proceeding from the same stock.

— The new steering apparatus for balloons invented by the two French officers of engineers, Capt. Renard and Capt. Krebs, is attracting considerable attention in warlike Europe. The experiments, for which Gambetta during his short lease of power obtained a grant of 100,000 francs, have been conducted for six years past in the forest of Meudon with the greatest secrecy. The two officers have admittedly been guided in their studies by the earlier labors of Mr. Duprey de Lôme in 1870-72. The conditions laid

down by the inventors themselves were stability of passage obtained by the cigar-shaped form of the balloon and the arrangement of the rudder, diminution of the resistance of the air by the choice of dimensions, and realization of a speed capable of resisting the winds generally prevalent in France. Capt. Renard undertook the more strictly scientific part of the work, and Capt. Krebs the rest. The former invented the new electric pile of exceptional lightness and power; and the latter constructed the screw and the rudder, and the apparatus for the electric motor. The balloon is formed in the shape of a cigar, pointed at both extremities; a net hangs from it, containing seats for two aëronauts, a directing apparatus, and a rudder. It is stated that the force is obtained by a series of electric accumulators of ten horse-power, which may be operative during

four hours. Of their first trip, the inve
the following report: —

"On Aug. 9, at four P.M., with the w
calm, the aërostat, with little ascensional
slowly to the height of the surroundin
The machine was put in motion; and so
stat increased its speed, obeying the slig
ment of its rudder. The route was fir
and south, toward Châtillon and Ver
the road from Choisy to Versailles; and,
to become entangled among the trees, t
was changed to Versailles. Above Villa
were about four kilometres from Chalai

feetly satisfied with the behavior of the b
decided to return and to descend at Chalai
standing the narrow space allowed by the tr
balloon was successfully turned to the righ
der making a small angle (about eleven
The diameter of the circle described was a
hundred metres; the dome of the Invali
as the point of direction, was a little to th
Chalais. After arriving above this point,
loon was easily turned to the left; and s
hovering three hundred metres above its
departure. It was necessary to work the
backward and forward, in order to bring th
above the place chosen for the descent.
metres above the ground, a rope dropped
balloon was seized, and the aërostat was
down in the very meadow whence it ha

Several times during the trip, the balloon underwent oscillations of from two to three degrees, resembling pitching; these oscillations were attributed either to

irregularities in the shape, or to currents of local air rising vertically." The balloon is 50.42 metres long, and 8.40 metres in diameter. The course taken, shown in accompanying map, was 7.6 kilometres long, and was finished in twenty-three minutes.

— We learn from the New-York branch Hydrographic office, that the bark Stillwater, Capt. Goudey, from Manilla to New York, passed through vast quantities of floating pumice from May 3 to 25 last, on its course from the Straits of Sunda until off Madagascar. From the 3d to the 8th (when in lat. 11° 49′ S., long. 95° E.), the pumice was very plentiful, with many large pieces; from the 10th to the 20th, in less quantity, with smaller pieces; from the 20th to the 25th, it was seen only occasionally, floating in long streaks with the wind. The pieces, up to six or seven inches in diameter, were covered with barnacles, by the weight of which Capt. Goudey thought it would eventually sink.

— There is hardly any subject in geographical bibliography so interesting to American scholars as the bibliography of Ptolemy's geography; and no one is better qualified than Mr. Justin Winsor to treat of it. His annotated lists of original and augmented text and translations have recently been published as *Bulletin No. 18* of the library of Harvard university. In addition to the titles, a description is given of every edition which is mentioned, with references to bibliographers' and sales catalogues, and with indications of the American libraries where copies may be found. American collectors have been diligent in their quest for Ptolemies, so much light is thrown by them on the cartographic development of the new world. The recent dispersion of the library of Henry C. Murphy has tended to the enrichment of many other libraries. Mr. Winsor mentions that President White of Cornell university has lately added several early editions to his collection. Mr. Winsor's critical notes are full of important and recondite lore, and deserve a much more careful *résumé* and discussion than our columns can afford.

— One feature of the year in Europe is the superabundance of insect life. The roses have been fairly eaten away with green-fly (aphis); cockroaches abound, and swarms of dragon-flies are reported in Silesia; on the morning of July 1 the sky is said to have been darkened by them at Ratibor, and on the 2d the same appearance was observed for half an hour at Reichenbach, and along the North Sea coast for five miles inland the same thing has occurred.

— The twenty-fifth general meeting of the German engineers society will be held at Mannheim in September, when the most interesting public works, private manufacturing establishments, etc., will be visited by the members. A special committee will report on the law of industrial protection (patent law, registration of trade-marks, etc.), another will report on steam-boilers and engines, and another on the practical education of young engineers. Among the papers to be read is one by Professor Hermann on the graphical treatment of the mechanical theory of heat, another by Mr. L. Post on the industry of Mannheim and surroundings. This society has now fifty-one hundred members, and has twenty-nine branches in various districts.

— The death of Prof. J. C. Schioedte, a prominent entomologist, and editor of the *Naturhistorisk tidsskrift*, at Copenhagen, at the age of sixty-nine, is announced.

— About ten years ago Mr. Krupp of Essen borrowed £1,500,000 to be repaid in yearly instalments extending to 1897; arrangements have just been made, however, for repaying within a short time the whole of the sum still remaining undischarged. These great steel-works, which are now in full operation, employ 19,000 work-people in the various departments.

— The results of Dr. Müller's investigations on the absorption of gases by steel, published in the Journal of the Society of German engineers, have been thus summarized in the *Ironmonger:* "The gas liberated from steel in the liquid state before solidification is chiefly carbonic oxide. The rising of steel, and consequently the formation of blow-holes, is attributed to hydrogen and nitrogen, and to a small extent to carbonic oxide."

— A new perfect-combustion stove for domestic use has been invented by Mr. Henry Thompson, of Canonbury, England. Externally it resembles the ordinary register-stove, but in its internal construction it widely differs from it. A recess at the back of the Thompson stove is filled with coal at starting; and behind the coal is a vertical hinged plate, which

is so arranged as always to exert a gentle pressure on the coal and the body of the fire, tending to push the coal forward toward the bars. A slight stirring of the fire causes it to be loosened, and the fuel to be pressed forward to the front to replenish the fire. When the coal has been consumed, the vertical plate is pushed back, and a fresh charge of coal inserted. It will thus be seen that the coal at the back is undergoing a process of coking before being pushed forward. The gases evolved from it, instead of passing up the chimney and into the air in the form of solid carbon, are carried downwards by the draught produced by an ingenious but simple arrangement at the back of the stove, and are delivered beneath the grate. At this point they are drawn upwards through the incandescent fire, in which every particle of smoke is consumed. The waste products of combustion pass up the chimney in the usual way, but without the usual attendant results of smoke and soot.

— A lady, who requests that her name may not be divulged, has offered the University of Heidelberg the sum of 100,000 marks if women are admitted to the lectures; but the senate refused.

— Sibiriakoff's steamers, the Obi and Nordenskiold, were to leave Arckangel on the 20th of June for the Petshora and Yenisei respectively.

— The Padas, Lawas, and Limbang Rivers of north-west Borneo have been visited by Consul-general Leijs. They lie between the Brunei district and the territory of the North Borneo company. They have been visited by but very few Europeans, and only in recent years. The Limbang appears to be navigable for river-steamers about one hundred and thirty miles, the Padas for one hundred, and the Lawas for only thirty miles. In the interior, on the banks of the two former, is a relatively dense population, occupying a flat country with many sago palms. The country on the banks of the Lawas is attractive, well wooded, hilly, but sparsely populated.

— Sir Erasmus Wilson, the great authority on skin-diseases, was buried in the village churchyard of Swanscombe in Kent, on Aug. 13. He was no less celebrated for his many deeds of philanthropy than for his knowledge of his profession, though his removal of the Egyptian obelisk Cleopatra's Needle to the Thames embankment was the latest thing that brought his name into public notice. It has been stated that the College of surgeons will receive a hundred and eighty thousand pounds as his residuary legatees; the Royal medical benevolent college, the Medical benevolent fund, and the Royal sea-bathing infirmary, Margate, will receive five thousand pounds each.

— The aërolus water-spray ventilator, which was fixed eighteen months ago in the physicians' consulting-room of the London hospital, has given such satisfaction to the medical staff, that another installation of the aërolus system in the throat consulting-room has been resolved on. The new University of North Wales, at Bangor, has also adopted the system.

— The *English mechanic* states, that many of the provisional orders granted by the board of trade for electric lighting in London will be revoked at once, and unless renewed before the 15th of October, or by that time utilized, nearly all of the remainder will be revoked; so that for the present there is little likelihood of London's being illuminated by the electric light.

— A cable message to Harvard college observatory, from Dr. A. Krueger, at Kiel, anounces the discovery of a bright comet, on September 17, by Wolf (probably Dr. Wolf, of the Zurich observatory). An observation was secured at Strasburg, on the 20th, as follows: September 20.4467, Greenwich mean time. R. A. 21h., 15m., 22.3s. Decl. +22° 22′ 54″. Daily motion in R. A., +20s., in declination +26′.

— The difficulty of soldering aluminium has been one of the principal bars to its usefulness. Mr. Bourbouze has recently communicated to the French Academie des sciences a process which obviates this difficulty. He uses alloys of zinc and tin, or preferably of tin, bismuth, and aluminium, which, he says, take upon the surface of aluminium as ordinary solder does upon other metals. He, therefore, coats the aluminium with these, and any other metal with tin; and then the surfaces may be soldered as usual. For objects which are to be worked after joining, he uses a solder of forty-five parts tin, and ten aluminium, which will stand hammering and turning. For ordinary joints, less aluminium is required. The process is effected with the common soldering-iron, but nothing is said as to the use of any flux.

— A light earthquake shock, lasting ten or fifteen seconds, was felt about 2.14 standard time through Ohio and the adjoining parts of Pennsylvania, Ontario, Michigan, and Indiana. There was no serious damage caused by it; but buildings were shaken, glassware was broken, furniture moved, dishes fell from shelves, and the people in some places ran out of their houses. The strength of the shock would thus seem to be about the same as that of Aug. 10 about New Jersey. Although the Mississippi and Ohio valleys are generally accounted free from earthquakes, the following list from Professor Rockwood's notes in the *American journal of science* includes a number from that region: In 1881 there were shocks in Indiana on April 20 and May 27, and in Ohio on Aug. 29. In 1882, in Illinois on July 20; a general shock through Indiana, Illinois, Missouri, and Kentucky, on Sept. 27; and again, feebler, at midnight of Oct. 14 and 15, over a similar area; and in Illinois on Oct. 22 and Nov. 14. In 1883, about Cairo, Ill., on Jan. 11; through Indiana, Illinois, and lower Michigan, on Feb. 4; and about Cairo on April 12 and July 6.

In the newspaper reports of the earthquake of Aug. 10, it was often incorrectly stated that the shock was felt in Wilmington, N.C. This was a mistake for Wilmington, Del. The few reports of buildings overthrown, and many of the accounts of overturned chimneys, were also incorrect. Special inquiry shows the first reports to have been exaggerated as usual.

SCIENCE.

FRIDAY, OCTOBER 3, 1884.

COMMENT AND CRITICISM.

THE reports of agricultural experiment-stations, experimental farms, and similar institutions, form a class of literature which is rapidly increasing in volume, and which, while it contains very much that is (at least from a scientific stand-point) simply trash, also contains much that is of scientific value. In calling attention to a very prevalent fault of such publications, we would not be understood as calling in question their usefulness for the purposes for which they are intended, and still less as lacking in appreciation of the valuable scientific results which many of them contain — usually, it must be confessed, rather sparingly. The fault to which we refer is not one of matter, but of form. It is the lack of any intelligent discussion of the results of experiments; and it makes itself felt most severely, precisely in the cases in which those results are most important scientifically.

What would be thought of an astronomer, who, after observing an eclipse, or a transit of Venus, should present as his report, simply a memorandum of the observations taken, without reducing or discussing them? Yet substantially this is what we find in very many agricultural reports. The experiments have been planned with more or less intelligence and care, and executed with more or less of painstaking accuracy, according to circumstances; but there the experimenter has stopped, apparently forgetting or ignoring that his work is only half done. The experiment planned and executed, there still remains the task of combining and testing the results, so as to detect their fallacies, and bring out what they really teach; in other words, the task of discussion.

That the task of discussion is so often neglected may be due to several causes. Often it is apparent from the tone of the report, that the author has feared the reproach of being a 'theorist,' and has rather ostentatiously confined himself to a bare statement of facts observed. Vague and undisciplined theorizing, and hasty generalizations, are, of course, to be avoided; but these are something very different from sober study and discussion. Facts are good, especially when they teach principles; but he who will have nothing but facts confines himself to the husks of investigation. In other cases one can scarcely avoid the impression that the writer has been too indolent to discuss his results; and in some instances the suspicion is even suggested that he has been overcome by their complexity or unexpectedness.

But, from whatever cause originating, the prevailing fashion of presenting experimental work is to be reprobated. An author has no right to require that his readers make that critical comparison of results which he is too indolent or too incompetent to undertake himself; nor to thrust upon the unscientific public, to whom such reports as we are speaking of are mainly addressed, crude and superficial conclusions as the results of scientific investigations. Indeed, it is to this latter class that the practice is likely to prove most pernicious. The trained scientific man can readily detect the absence of critical discussion, even though he may not feel called upon to supply the lack; but the unscientific reader, who has had no training of this sort, is very likely to accept whatever conclusions his author draws, however inadequate, as expressing the sum of truth upon that subject, or to stand bewildered before a mass of details, with no clear idea of what they prove.

We submit that in neither case is the experimenter fulfilling his duty to his constituents.

When the public funds are to be expended in scientific investigation, the public has a right to demand that the work be put into the hands of those who are not only industrious experimenters, but who are able and willing to test critically the results of their own experiments, and present to the public only results which have endured such testing.

WHEN the president of the geographical section of the British association declared that the Portuguese 'lost colony,' as described by Mr. Haliburton, 'was something quite new to geographers,' he doubtless failed to recall that in 1881 Bettencourt (Descobrimentos . . . do Portugueses, pp. 132–135) printed the grant to Fagundes of March 13, 1521, which is also contained in Do Canto's Memoria historica, p. 90. The whole subject of the discoveries of Fagundes is taken up by those authors, and also by Henry Harrisse in his Cabots, pp. 275–277 (Paris, 1882), and in his Corte-Real, p. 144 and 171 (Paris, 1883). General Lefroy also failed to remember that Ernesto do Canto, the learned antiquary of S. Miguel, one of the Azores — to whom Harrisse acknowledges his indebtedness — discovered among the manuscripts of the Torre do Tombo a *carta* of the 4th May, 1567, relating to the second lost Portuguese colony mentioned by Mr. Haliburton. This document is in Do Canto's Memoria historica entitled Os Corte-Reaes, p. 161 (S. Miguel, 1883); and also in the appendix to Harrisse's Corte-Real, p. 235, where it is stated that it was communicated by Mr. Do Canto. These three books, and others which we have no space to mention at this time, contain documents going to show that those expeditions actually sailed, and also contain the commissions and confirmations granted the Corte-Reals, their contemporaries and successors, at various times.

THE occurrence of two light but wide-spread earthquakes within two months in our usually quiet eastern states awakens attention to the absence of any organized attempt to observe them. The chief difficulty in such an attempt would doubtless be the discouragement of waiting through a considerable time without shocks to observe; but this time is not so long as many would suppose, as may be seen by looking over Rockwood's earthquake lists. The only systematic work now undertaken consists in the collection of accidental records by Professor Rockwood and some few other students of the question, and the reporting of ordinary non-instrumental observations from the signal-service stations. This small beginning could be greatly improved if the U. S. geological survey could lend a hand by providing simple seismometers for a moderate number of stations; and would be still further advanced if observers and students of this branch of physical geography would resolve themselves into an earthquake-club, unembarrassed by formal regulations, chiefly with the object of becoming known to one another, and thus insuring the proper collection and collation of their observations. We should be glad to have correspondence on this subject.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Classification of the Mollusca.

IN the instructive comments on the 'classification of the Mollusca' by Messrs. Dall and Lankester, *apropos* of Professor Ray Lankester's article 'Mollusca' in the 'Encyclopædia Britannica,' several points are raised concerning which I should be pleased to be better informed.

In the original review by Mr. Dall (*Science*, iii. 730), it is remarked that 'no single instance of a calcified jaw among recent Mollusca occurs;' and in his reply that gentleman adds, that he "should be grateful to Professor Lankester for the name of any recent mollusk having a shelly or even partially 'calcified' jaw" (*Science*, iv. 143). I have long been under the impression that the Nautilidae furnished such an instance. Woodward expressed the belief of malacologists in his statement, that, "in the recent Nautilus, the *mandibles* are horny, but *calcified to a considerable extent*;" and Professor Lankester (*op. cit.* p. 667) says that in the cephalopods ('Siphonopoda') "the jaws have the form of a pair of powerful beaks, either horny or *calcified* (*Nautilus*)." Is there any reason to doubt or dispute the correctness of such and similar statements?

In my 'Arrangement of the families of mollusks' (1871), I admitted as orders of Acephala (otherwise Conchifera, or Lipocephala) the Dimyaria, Heteromyaria, and Monomyaria, but under mental protest. I

was aware of the apparent exceptions signalized by Mr. Dall, and could add extinct forms referred to the Pteriidae or Aviculidae, as well as the Muelleriidae retained among the Dimyaria. The Monomyaria seemed to me, however, to be a natural 'genetic' group, and the Muelleriidae were bimusculose in youth, and their monomyarian characteristics in the adult appeared to be a peculiar teleological adaptation. I am still disposed to believe that the Monomyaria constitute a natural group, although Mr. Dall has good reasons for thinking that, "in fact, there does not at present seem to be any good basis for ordinal divisions in the Lipocephala." What Mr. Dall designates as 'the remarkable characters of the group of Metarrhiptae' seemed to me to furnish as good a basis for an 'order' as any of those that have been used for that purpose: consequently I gave the name as an ordinal designation in 1871.

But the question whether certain groups are of ordinal or minor value is of less moment than the natural subdivision of the class. If the myological peculiarities are not the best criteria, what are?

A view that has had some currency, that the Monomyaria are inferior forms of Acephala, is negatived by both embryological and paleontological evidençe. The testimony of both is conclusive that the Monomyaria are derivatives from Dimyaria.

Is it certain that the shell of the Polyplacophora (Chitons) is the exact homologue of the shells of the typical Gastropods? I am acquainted with what has been published of the embryology of the group, but am left in doubt both as to facts and interpretations. At any rate, it is certain that the old views of a close relation between the Polyplacophora and the docoglossate Gastropoda had very little morphological basis.

My gratitude for the excellent article of Professor Lankester impels me to cordially indorse the encomiums of Mr. Dall, while I concur with the critic as to the family arrangement.

Professor Lankester has sometimes been misled, too, by not remembering that the same objects may be called by different names: for instance, he has referred to the 'Rachiglossa (1.1.1, or 1),' a gastropod named '*Pyrula*, Lam. (fig. 38),' but the figure represents a type belonging to the 'Tenioglossa (3. 1. 3),' and repeated thereunder as one of the 'family 4, Doliidæ,' under the name '*Ficula*.' As my eyes light on neighboring names, I may add that the '*Pediculariidae*' and '*Ovulum*' do not fulfil the conditions of the 'Siphonochlamyda,'— 'shell always spiral:' they do not have true spires. Professor Lankester has been deceived by false guides. Such lapses are, however, of a kind inevitable in a general work; for it is impossible for one man to verify every statement. THEO. GILL.

A fasting pig.

IN a recent flood (June 26) that visited this neighborhood, Mr. John Aughenbaugh of West Manchester township had five hogs carried away by the water. On Aug. 7 one of them was found under a large heap of driftwood about a mile from the home of Mr. Aughenbaugh. The animal had been securely imprisoned by the timber, and had not eaten any thing for forty-two days. Although very considerably emaciated when released from its prison, it appeared to have no trouble in emptying a crock of thick milk that was offered it. It has since been doing well, and no doubt will soon recover all it lost in flesh. E. F. S.

York, Penn.

A WIDER USE FOR THE LIBRARIES OF SCIENTIFIC SOCIETIES.

To those who are obliged to use the libraries of our smaller colleges, it is often a source of vexation to find that the books one is referred to are wanting. The resources of the colleges are limited, and the amount of money which can be expended for the purchase of new books small, and that small amount often devoted, according to the wishes of the donor, to the class of books least needed. A case in point occurred lately, where a college professor of mathematics was asked to write a short account of the life of Todhunter; and he felt obliged to say that he would be glad to undertake the article, but could not before he had visited the libraries of either New York or Boston, which he hoped to be able to do during his next vacation.

This constant lacking of just the books one needs for his work is most hampering. It is not the *Century*, or the *Harper*, or the latest novel, or the new book of travel, which cannot be had (these find their way into all the odd corners), but it is the specialist's books, a volume of the transactions of some learned society, a scientific journal, or the modern treatises on thermo-dynamics, on electricity, or on biology, which are needed, and which can be found only in a very few of our libraries in the necessary profusion.

A few such libraries have now been collected by our older scientific societies and our larger colleges. The books of the college libraries are for a specific purpose, and find abundant use at the hands of the students and professors. With the societies the matter stands differently. It cannot be denied that one of the original objects of the establishment of these societies was, that, by the publication of their own 'proceedings,' they might, by exchange, gather a collection of books which could not, in the then comparatively poor state of the country, be gathered in any other way, and which were to be for the use of the members, and such favored friends as they might designate.

It has so happened that these societies were established by the small knots of scientific

men gathered about our larger colleges. These colleges have developed, and their libraries have grown more and more valuable; so that the professors no longer find it necessary to go to their academy for books. At the same time the machinery of their long-established organization has grown more effective; and, while many of the members no longer need their society collection of books, the number and value of those added to the shelves each year are constantly increasing. The result is, that in some of our larger cities there are accumulating very considerable libraries of special works which are scarcely used, as they are duplicated at some neighboring college about which those employing such books live.

It is, of course, with regret that one enters such a library, if library it may be called, and sees the new books which are not called for by the former clientage of the collection, but which would eagerly be asked for if the circle of favored outsiders were widened so as to include all properly vouched-for persons who might live within one, two, or three hundred miles, or even more, and who would be willing to pay a small annual fee to defray the expense of sending books to them by mail or express, and for the extra wear, and danger of loss. It is true that such books as could not be readily replaced in case of loss would necessarily be retained from such a wide-spread circulation; but these would be only the older volumes of the various series, and such books as are very generally kept from such extra risks.

The expense of mailing would be considerable; it would average, on volumes of the size of a bound volume of the *American journal of science*, about sixteen cents each way. To this must be added the cost of handling, and some slight charge for the privilege of use. Altogether, the expense of taking out, say, forty books of this class in the course of the year would be in the neighborhood of ten to fifteen dollars, — a charge which could be reduced very materially by sending for the books a number at a time, so that they might be forwarded to advantage by express; the amount named above being the maximum if each book were mailed separately.

That the expense of using a library through the mails would mount up very rapidly is evident; but the facts remain, that there are large libraries of books solely on matters of interest to scientific men, and of vital interest to such men, and that these libraries exist in communities where by duplication they no longer have their former use. It is highly desirable that the books should be put to use; and their owners would probably be glad to arrange some plan by which the scheme of extending the circulation through the mails could be made practicable. It would be of great advantage in perfecting plans, if those who might be benefited would come forward and state their position.

THE COLOR-SENSE IN FISHES.

In his recent volume on 'Mental evolution in animals,'[1] Mr. Romanes remarks, "As further proof that a well-developed sense of color occurs in fish, I may remark, that the elaborate care with which anglers dress their flies, and select this and that combination of tints for this and that locality, time of day, etc., shows that those who are practically acquainted with the habits of trout, salmon, and other freshwater fish, regard the presence of a color-sense in them as axiomatic." As one 'practically acquainted' with some sixty species of freshwater fishes, representing a dozen or more distinct groups, I am reminded, by the above quotation, of many occurrences witnessed during my rambles about the Delaware River, or its tributary creeks, that have a bearing upon the subject. Besides recognizing the differences in insects by their colors, have fishes any knowledge of the fact that their own colors may or may not be protective? Are they aware that it depends upon themselves, whether these colors shall be a safeguard, or a source of danger? That we are warranted in giving an affirmative reply, is shown, I think, by their habits, and particularly by the fact that to a certain extent they have the color of their bodies under their control.

Relatively speaking, the fishes of the Delaware River and its tributaries may be classified, in regard to their habits, as diurnal and

[1] Mental evolution in animals, by GEORGE J. ROMANES. New York, *Appleton*, 1884. 411 p. 12°.

nocturnal. It might almost be said that there are no 'fixed' habits. I have found marked variations in every one of the most characteristic habits of our birds; and can see no reason why the same degrees of variability should not likewise obtain among mammals, reptiles, and fishes. In considering fishes as either nocturnal or diurnal, I mean that they are so to about the extent that owls are; i.e., ranging from species as diurnal as hawks to those that are nocturnal, or, properly speaking, crepuscular. How often we hear the phrase, 'as blind as a bat'! yet these mammals are not averse to daylight, and only shun the glare of noonday. In shady woods they are often found insect-hunting by day; and fly just as freely, and range abroad as generally, on cloudy days, as during the gloaming throughout midsummer.

Several years ago, when studying our fishes with reference to detecting supposed traces of voice possessed by them, I concluded that the nocturnal, dull-colored species had the power of uttering certain sounds, especially during the breeding-season; while the diurnal fishes were apparently voiceless, and were dependent upon their gaudy coloration as a sexual attraction. More recent observations have led me a step farther, and I am convinced that the colors of many species continue to play an important part in the struggle for existence throughout the interim from one breeding-season to the next. It must be remembered that fishes, when undisturbed by man's presence, are very different from the frightened animals that rush hither and thither in the most reckless manner when startled by his sudden appearance. We have only to take a favorable position, and, ourselves unseen, to gaze patiently into their accustomed haunts, to realize what animated, cunning, and mentally well-developed creatures fishes really are.

That curious group known as 'darters,' or etheostomoids, is always to be found, when not in motion, resting upon the bottoms of streams; and I have never found these fishes in localities where their color did not closely resemble the sand, mud, or pebbles upon which they rested. I have tested them in this matter in the following manner. Finding a spot in a small stream where many of these fishes congregated, I placed a large number of white-porcelain plates in the stream on a level with the surrounding sand. On disturbing the 'darters,' I found that they invariably settled between these plates, and never on them; and this after the dishes had been several days in position. Finally the currents covered the plates with a thin coating of sand, and then occasionally a 'darter' would come to rest upon one of the plates. The motion of his fins in so doing usually displaced the sand, and exposed the

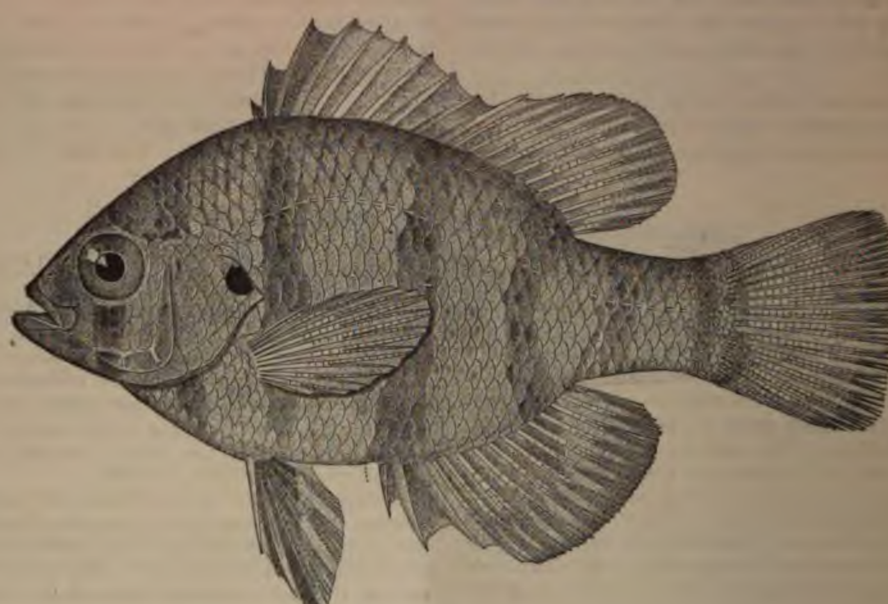
Mud-minnow (*Umbra limi*).

white surface beneath: if so, the fish darted off, and settled between the plates or beyond them. It is evident, I think, that protection through their color must be quite essential to them; more so in the matter of procuring their food, perhaps, than as a safeguard against the attacks of enemies.

The mud-minnow (Umbra limi) depends very largely upon insects and smaller fishes for food, and the question of color is a prominent one in its life history. This fish frequently assumes what we may call an 'inanimate' position, and, with a variety of colors streaking and spotting its sides, has much the appearance of a bit of dead grass, a twig, or a caddis-worm. Often such unnatural positions will be retained for many minutes, or until some object suitable for food comes within reach, when it darts at and seizes it with the rapidity and certainty of a pike. Now, in all such cases, there is great and constant changing of color. Often the tints deepen until the fish appears to be inky-black, then pale until, from above, we can scarcely detect the fish. Such changes, of

course, are very significant, and can only be explained as being serviceable to the fishes in rendering them inconspicuous, both to their enemies and to the wandering animal-life on which they prey. In precisely what way the extreme variations from very dark to pale are serviceable, is not yet known, so far as I am aware; but the fact itself can scarcely be used to the disadvantage of the main proposition, that the color and its changeableness are of benefit to the fish, and are under the animal's control.

I think we have, in the fact that usually they deposit their ova and milt in rapid waters. Waters with a constantly rippling and troubled surface certainly protect them from such enemies as the kingfisher, fish-eating mammals, and probably from frogs and snakes. By drawing a seine through turbulent water at the foot of a mill-dam, I have frequently found scores of splendidly colored cyprinoids; and finally, very soon after spawning, all these extra tints fade out utterly, and the fishes return to their accustomed haunts. These facts



BANDED SUN-FISH (*Mesogonistius chaetodon*).

During the early spring, when the vigor of these fishes is at its maximum, the coloration is more pronounced in every particular; and the continual changing from dark to light, and *vice versa*, as seen in connection with its other habits, shows plainly that it is as much under control as are the folding and spreading of a peacock's tail.

The cyprinoids, or 'shiners,' known collectively as minnows, roach, and dace, so many species of which are conspicuously colored at least at one time of the year, are all essentially diurnal in habit. Their bright colors, as a sexual attraction, are essential to their welfare, but are, at the same time, detrimental to their safety. Have we any reason for believing that these fishes seek to avoid exposure to enemies when thus arrayed in extra-conspicuous dress?

certainly seem to indicate that they are aware of the disadvantage of unusually bright colors, which, notwithstanding, are essential to the perpetuation of their kind.

The common banded sunfish (Mesogonistius chaetodon), a silvery-white species, has a remarkable control over the color of the black vertical bands that ordinarily form so conspicuous a feature of the fish. At times when the water is rather clear, and the amount of vegetation not abundant, this sunfish will fade out, and show such ashen, faintly streaked sides, that it might almost pass for a dead leaf; but roused to action by the approach of other fishes, or the finding of food, the dull sides glisten like polished metal, and the faint bands become as black as ebony. Certainly these great and sudden changes are not involuntary. They

ened to blushing, but are evidently sh's control, and are intelligently dvantage.

gar (Lepidosteus osseus) is an-ving decided control over the col-s scales. When this fish is at rest, e pale blue, with a pink margin; he head and gill-covers there is a rilliant hues. At times all these ddenly disappear, and the fish has he appearance of a water-soaked f a living animal. Unfortunately oo few opportunities for observing to determine the reasons for these it it is evident that they are under of the fish, and therefore advan-

non pike (Esox reticulatus) also riation of coloring, under different es, and suggests the same facts that have already been stated with regard to other species.

When the chief aim of biological science seemed to be the naming and describing of 'species,' it was found that no description of the color of a fish, unless very unusual and marked, was at all satisfactory. Considering the subject of color, as I have in this article, the cause is very evident.

In an early number of *Science*, I offered many reasons for believing that fishes were very far from spending as joyless, machine-like an existence as has been supposed. Those reasons I supplement with the results of studies of their habits, with reference to their brilliant tints and sombre hues, and am in accord with Mr. Romanes when he states that we are justified in regarding 'the presence of a color-sense in them as axiomatic.'

CHARLES C. ABBOTT.

CAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

INGS OF THE SECTION OF BIOLOGY.

umber of papers (forty-three in all) were re the section of biology, but we regret imited space we can give merely the es. The first we may mention was a H. G. Beyer, on the influence of oxy-noxygenated blood, as well as of blood rees of dilution, on the isolated heart of errapin. The paper aimed to prove that entrated mammalian blood which pro-atest amount of work done in either the frog or that of the terrapin, but a e of dilution is necessary. There is no the constant, stimulating influence in lood, and none in the depressing effect ated blood.

linot read a paper on biological prob-thor opposed the trinomial system, and e present mode of determining species entific, and thought that the species ed on a statistical study of all the vari-e known to occur. Individuals are not logous. The only fixed units are, 1° whole series of generations of cells from , — a cell-cycle. An individual may be actional part of a cell-cycle. Roughly higher the organism, the fewer the ndividuals it comprises. The author ovum to be homologous with the en-oon, the zona radiator being equivalent or cyst of the protozoon, and the con-nologous.

y Lillie J. Martin on a botanical study ll found on the petiole of Juglans nigra, known as Erineum anomalum Schw., a general survey of the gall was given, as to position, number, general appearance, etc. This was followed by a description and comparison of the microscopical appearance of the gall and normal petiole, concluding with the supposition that the mite entered at an early period in the life of the petiole, and the growth of the gall was from within outward.

A paper by Prof. B. G. Wilder, on the relative position of the cerebrum and the cerebellum in anthropoid apes, was illustrated by photographs, and a preparation of a chimpanzee's brain; conclusively settling the much-disputed point, as to whether the cerebrum extended over the cerebellum or not, as the cerebrum was seen to extend at least a millimetre over the cerebellum.

Mr. E. D. Cope, in a paper on the phylogeny of the artiodactyle Mammalia derived from American fossils, considered the derivation of the seledont dentition from the bunodont as established from a mechanical point of view. The oldest American artiodactyl (Pantolestes) is bunodont. The modification proceeded as in other ruminant lines by the co-ossification of the bones of the legs and feet. The peculiar structure of the carpus in the Oreodontidae shows them to be, without doubt, the ancestors of the Tragulina. The following table represents the present views of the author on this subject.

Tritubercular Bunodontia (Pantolestidae).

Selenodontia. Quadritubercular Bunodontia.

Hyopotamidae.	Oreodontidae.	Poëbrotheriidae
(?) Pecora.	Tragulina.	Tylopoda.

In a paper on the torsion of leaves, Prof. W. J. Beal stated that he had studied the torsion of leaves produced by the effects of sunlight. Those twisting with the sun are two species of Typha, one species of Sparganium, Acorus, Tritallaria imperialis, and Liatris. Those twisting against the sun are two species of Allium, Iris, Gladiolus, oats, and Setaria. Twisting both ways are Allium cernuum, Phleum, Bromus, barley, Clawson wheat, Panicum, and Zizania. Cyperaceae, Setaria verticillata, S. viridis, and S. italica do not twist at all.

Mr. L. F. Ward read a paper on the fossil flora of the globe; treating the subject from historical, geological, and botanical standpoints.

The two oldest known species (Oldhamia) have been found in the Cambrian of Ireland. From the lower Silurian, 44 species are known, being chiefly marine algae; upper Silurian, 13 species. The ferns predominate among the 188 species known to the Devonian. In the Permo-carboniferous, nearly 2,000 species have been made out, while in the trias 67 are known. In the Rhetic, an advance seems to have been made, which increases to the oölite where 419 species have been found. The upper Jurassic and lower cretaceous are sparingly supplied with vegetal remains. The Cenomanian of Atam, Greenland, and the Dakota group of Kansas and Nebraska, give 500 species. The Turonian again is almost destitute. Senomanian yields 350 species, while the Laramie group of western United States gives 333 species; the tertiary eocene, 800; oligocene, a somewhat larger number, while the miocene gives more than 3,000; the pliocene gives only 150 species.

The first type is that of the Florideae, marine algae. Ferns, Equisetineae and Lycopodineae, appear in the lower Silurian. The Devonian of Canada and Brazil shows us the first appearance of the rhizocarps, while the monocotyledons first appear in the carboniferous. The dicotyledons have their first known representative in the Urogonian of Kome, Greenland. All the leading types of vegetation are introduced without going later down the geological scale than the middle cretaceous. Marine algae predominate in the Cambrian and early Silurian. Ferns flourish in the Permian; Equisetineae and Lycopodineae, in the carboniferous; Cycadaceae, in the lias or oölite; the Coniferae, in the Wealden; monocotyledons, in the eocene; monochlamydeous dicotyledons, in the cenomanian; polypetalous dicotyledons, in the miocene; and the gamopetalous dicotyledons, in the present living flora of the globe. Cellular cryptogams of some kind lived in the Laurentian, and account for the graphite beds there found. Ferns, Equisetineae and Lycopodineae, commenced in the lower Silurian, and had their maximum in the carboniferous. Cycadaceae have their origin in the Devonian, while the maximum is in the middle Jurassic. The Silurian shows the first Coniferae, which reach their maximum in the cretaceous, and then decline. Monocotyledons begin in the lower carboniferous, and have their maximum in the tertiary. Dicotyledons commence in the lower Jura, and the maximum is in the present age.

In a paper on fertility in hybridization, Mr. R. B. Roosevelt cited cases of hybridism between species of Salmonidae, and between Alosa sapidissima and the striped bass. In many cases hybridism greatly improves the species. He proved by an extensive practical knowledge that hybridism in fish at least by no means necessarily implies sterility.

Mr. H. F. Osborne presented observations on the amphibian brain, containing results of microscopic study upon the frog, Menobranchus, Menopoma, and Amphiuma. His method of study was by making series of sections, in three different planes. The relative position of gray and white matter was the same as that found in the spinal cord of these and other vertebrates. The course of the principal nerve-bundles extending from the medulla forward to the hemispheres was described, showing the course of the transverse commissures, and a commissure hitherto overlooked in the roof of the third ventricle was pointed out. This demonstrated that each brain segment had its own dorsal commissure. The differences of the cerebellum in the Anura and Urodela were pointed out, and the resemblances of the latter to the mammalian brain were dwelt upon. The pia blood-vessels are all sent in upon the anterior face of the pituitary body. The pineal elements were shown to consist of certain very inconspicuous foldings of the epithelium of the roof of the third ventricle, which have been generally overlooked. These foldings represent what remains of the stalk of the pineal gland.

Mr. S. Garman's paper on Chlamydoselachus, the frilled shark, treated of the internal anatomy of this peculiar shark. The nearest forms are Notidanidae, Hexanthus, and Heptanchus. Hind and fore brain resemble that of foetal sharks; the cartilage is soft; the lateral line is open as in foetal sharks, and continued to the end of the tail. The pelvis is twice as long as broad: the nearest resemblance to this is seen in the foetal Heptanchus.

The next paper was by Mr. E. D. Cope, on the mammalian affinities of saurians of the Permian epoch, and referred to the detection of mammalian resemblance between Theromorpha and reptiles of the Permian epoch. Resemblances in the pelvic and scapular arch were pointed out. The quadrate bone was discussed, referring to the theory of Albrecht. The genus Clepsydrops shows that it has the mammalian number of bones in its tarsus, and the resemblance was nearest to that found in the Platypus anatinus.

Dr. C. H. Merriam gave a paper on the hood of the hooded seal (Cystophora cristata); describing it as an inflatable proboscis overhanging the mouth, and extending posteriorly to a point behind the two eyes, lined with nasal mucous membrane, and divided longitudinally by two cartilages. It is not noticeable until the male has reached its fourth year.

In a paper on some points in the development of pelagic teleostean eggs, Mr. G. Brook, jun., first considered non-pelagic eggs; instancing those of trout, in which the hypoblast originates as an involution of the lower layer upon itself, the space between the

being quite distinct. In pelagic eggs the pro- quite different. Sections of the eggs of Trachi- para at this stage show that the parablast of the intermediate layer of American authors, is up of a large number of free cells, and nuclei sorbed from the yolk, which contribute to a very extent to build up the hypoblast. In this case, is no true invagination. In Motella mustella rigin of the hypoblast is similar to that of inus; but the resulting cells, instead of being similar to the original ones as usual in teleos- eggs, are very much larger, and hexagonal, so hey cannot be derived directly from the lower of cells. The author sustained the views of as regards the segmentation cavity in pelagic He also holds that there is no circulation in c embryos before hatching.

G. Macloskie, in his paper on the dynamics of sect crust, commenced with a general descrip- f the chitinous skeleton with its in- and out- hs, etc. The tracheae have spiral crenulations, have been hitherto misunderstood and sup- to be threads; these tracheae transmit gases y to the tissues, and the blood is not used for irpose. The tracheae are not directly controlled scles; their action depending on the successive tion of a partial vacuum, and condensation of und them.

. A. Hyatt read a paper on the larval theory origin of tissue, stating that the building-up of ssues of the metazoa is due to a quick and division of cells. Minot's theory that the ori- the sexes is due to the difference in cell ele- was supported. The author considered the a a more primitive form than the gastrula. In r paper Professor Hyatt presented objections e commonly accepted views of heredity; assert- at heredity has no need of the gemmule hy- is or pangenesis, but that it can be equally well stood upon the supposition that the nuclei of re the immediate agents of the transmission of teristics. The author presented the case of a Maine who resembled the mother on one side body, and his father on the other side, as an ation of his theory; and he contested the posi- f Professor Brooks as regards heredity. In a on the structure and affinities of Beatricea, the uthor stated that this fossil has had many posi- ssigned to it in almost all the groups of the ebrata, though he himself now thought it a for- er. Thin sections were examined, the struc- ing found to consist of cells joined by a stolon.

C. S. Minot presented a paper on the skin of . The skin consists of three layers, — exter- he cuticula, overlying an epithelium, which lies on a sheet of connective tissue; the epithe- homologous with the epithelium of other ani- and which should be so called instead of hy- nis; and dermis, which name should be applied connective tissue, as it is the homologue of vertebrates. The cuticula of caterpillars has been fully described: it consists of two layers, one and a thin one.

In a communication on the development of Limulus, Mr. J. S. Kingsley stated that his account begins after the formation of the blastoderm. At this time there is a single layer of cells surrounding the yolk, in which are scattered nuclei. The mesoblast arises as a single sheet on the ventral surface. Its cells come largely from the blastoderm, but some arise from the yolk nuclei. The mesoblast soon forms two longitudinal layers, one on each side in the neighborhood of the limbs. The coelom is formed by a splitting of the mesoblast, and at first consists of a series of metameric cavities extending into the limbs. The supraoesophageal ganglion arises by an invagination of the epiblast. The heart arises as two tubes in the somatophore, which later unite. The mesenteron does not appear until after hatching. The amnion of Packard is the first larval cuticle, and bears a resemblance to the amnion of the tracheata. A second cuticle is formed and moulted before hatching. The eyes appear on the dorsal surface at the same time that the limbs appear on the ventral. In these characters Limulus agrees essentially with the tracheata, and has nothing in common with crustacea.

Prof. B. G. Wilder, in a paper entitled, 'Do the cerebellum and oblongata represent two encephalic segments, or only one?' remarked that most writers had considered two segments to exist. The cephalad of these segments is held to include the cerebellum, together with the portion of the 'brain-stem' immediately connected therewith and the latter part of the oblongata. The only writers that have admitted of a single segment caudad of the mesen are Balfour, A. M. Marshall, Owen, and Spitzka. The views of Spitzka were then discussed; concluding with the opinion that sufficient evidence to settle the question was wanting.

Dr. J. A. Ryder presented a paper on the morphology and evolution of the tail of osseous fishes. The caudal fin of fishes is developed in the same way as the other median or unpaired fins, from a median fin-fold. After the protocercal stage of the larva is passed, a lower caudal lobe grows out, which is probably the homologue of a second anal fin. The hypotheses which grow out of a consideration of the facts of the development of the tails of fishes, are the following: 1. Whenever heterocercality manifests itself, there is a more or less extensive degeneration of the caudal end of the chordal axis, which began to be somewhat manifest far back in the phylum in such forms as Holocephali, Dipnoi, and crossopterygians. 2. With the outgrowth of the lower lobes (second anal) the energy of growth tended to push the tip of the chorda upward; the lobe itself arising, probably in consequence of the localization of the energy of growth and the deposit of organic material at the point according to the demands of use and effort. 3. Local use and effort, acting as constant stimuli of local growth, carried the heterocercal condition and its accompanying modification of degeneration and reduction still farther, as is shown by a study of the homologous elements in the tails of fishes; while use and effort would also continue to augment heterocercality, until the inferior and superior lobes were

about of the same length and area, when the morphological characters of the caudal fin would become approximately stable for any one species, as may be shown by measurements of a simple mechanical illustration, in which the interaction and composition of the forces which are brought into action are demonstrated. 4. The mechanical demonstration alluded to above, taken together with the fact that the primitive or ancestral form of the tail, which is typified by a temporary condition in fish larvae, when the myosomata are rudimentary, but still symmetrical, amounts almost to a demonstration of the principles first laid down by Lamarck, then elaborated by Spencer, and more recently applied to special cases by the author and Professor Cope.

In a communication on growth and death, Dr. C. S. Minot gave the results of ten thousand measurements of weight of growing guinea-pigs and other animals from birth to maturity. The rate of growth was found to steadily diminish from birth onward; so that the loss of power begins at once, and continues until death. The common views of death were discussed, and the current conceptions of animal individuality were attacked. The author then referred to the bearing of our present knowledge of senescence upon the theory of life, and the relation of life to a material substratum.

A paper on the osteology of Oreodon was read by Mr. W. B. Scott, in which this genus was said to belong to the Artiodactyla, although there are some strong resemblances to the Suidae. Vertebrae are ruminant, markedly in the case of the axis. Thoracic vertebrae have long prominent spines, and small bodies slightly amphicoelous. Lumbars, probably five in number, are heavy, with short spines and broad flat transverse processes. Sacrum contains two vertebrae which touch the ileum. The tail is long and slender, and the legs proportionally long. There are a short head and short metapodials, giving the animal a wolf-like appearance. The radius and ulna are distinct. The carpus consists of eight bones, including the pisiform. There are short unankylosed metacarpals. The ungual phalanges are long and pointed, as in Hyopotamus. A rudimentary pollex is present, this being the only artiodactyl with one.

Mr. J. Struthers, in a paper on finger-muscles in Megaptera longimana, and in other whales, records rudimentary flexor and extensor muscles in these animals, and shows that they are more or less used, as the muscular fibres are red and not degenerated.

Dr. G. M. Sternberg described his experimental research relating to the etiology of tuberculosis. The author repeated the inoculation experiments of Koch, with similar results. The experiments of Formad to induce tuberculosis in rabbits by introducing into the cavity of the abdomen finely powdered inorganic material, have also been repeated with entirely negative results. The author held that Koch's bacillus was an essential factor in the etiology of tuberculosis.

Dr. C. E. Bessey, in a paper on the adventitious inflorescence of Cuscuta glomerata, stated that the examination of young plants shows that the inflorescence is developed from numerous crowded adventitious buds, and not by the repeated branching of axillary flowering branches as commonly stated.

In a paper on the hitherto unknown mode of oviposition in the Carabidae, Prof. C. V. Riley records habits of Chlaenius impunctifrons, traced from the egg up. The eggs are laid singly in cells made of mud or clay, on the under surface of leaves.

Mrs. A. B. Blackwell read a paper on the comparative longevity of the sexes. The study was exhaustive, and made on statistics from all parts of the world; and the greater longevity of woman over man was established. In old countries the females preponderate, while males lead in newly settled ones. Up to eighteen years the males are in excess of the females: later the females predominate.

PROCEEDINGS OF THE SECTION OF HISTOLOGY AND MICROSCOPY.

THE attendance at this section was very small, partly because the other sections drew away not only many members, but many papers also; partly too, we imagine, because the American society of microscopists had held its annual meeting a short time previously. The future of this section is somewhat uncertain, especially because many of the members are unwilling to have their histological papers withdrawn from the section of biology. The abolition of the section was much discussed, not only among the members interested, but also in the section itself. As the number of communications and the attendance were both of the smallest, the feeling against the continuance of the section, with its separate organization and equal rank with the sections of physics, biology, geology, etc., became very decided with many of those most interested. Finally, Dr. C. S. Minot announced in general session, that he should bring up a motion to amend the constitution so that section G shall be abolished. This amendment will come up for consideration at the next meeting of the association.

Alexis A. Julien read a paper on an immersion apparatus for the determination of the temperature of the critical point in the fluid cavities of minerals. The extensive occurrence of carbon dioxide in minerals renders the determination of its critical point important; yet with the forms of apparatus hitherto described for this use, there have been sources of serious error. The author described a new device for raising a thin section of a mineral, mounted on a glass slide, to an accurately determinable temperature upon the stage of the microscope. The arrangement consists of a thin walled box heated by conduction from a taper through the copper plate which forms its bottom, and which projects beyond the stage. The thermometer has a scale ranging from 22° to 45° C.; each degree on the scale being two centimetres in length, and divided into tenths. The bore and length are so arranged as to bring that part of the scale near 30° on a level with the eye at the eye-piece, in order

to facilitate quick readings without moving the head. The box serves as a water-bath in which any objective from one-half to one-tenth may be immersed without serious loss to the objective's optical capacity. The critical point of the fluid may be readily determined in ten minutes by both the disappearance and reappearance of the bubble within a twentieth of a degree. For further details the author referred to his earlier paper upon an apparatus for this purpose.

Dr. Theobald Smith presented an account of Salmon's culture-tubes; but as it has not yet been revised by Dr. Salmon, we postpone notice of it.

Prof. Henry F. Osborn's paper upon a microscopic method of studying the amphibian brain was valuable. The brain is hardened in 'Müller's fluid,' the ventricles being fully injected. After the usual alcoholic treatment, the brain is placed for one week in a carmine solution, then for twenty-four hours in acetic acid. The embedding mass is prepared by shaking the contents of an egg with three drops of glycerine. After soaking in this mass, the brain is placed in position, and hardened in the vapor of boiling eighty-per-cent alcohol. The mass is then placed for one week in absolute alcohol. Section is made under alcohol with a Jung's microtome. The sections on the slide are arranged, covered with old-fashioned blotting-paper (cigarette-paper was suggested as better by Dr. C. S. Minot), and treated with alcohol and oil of cloves through the paper, a device which may prove convenient in many cases.

Dr. H. G. Beyer reported one of his observations made during his still uncompleted researches on Lingula. In his abstract he says, "One of the points that I should like to demonstrate from one of my sections is a probable communication of the so-called segmental tubes with one of the diverticula (liver) of the alimentary canal of the animal, by means of a convoluted tubule;" certainly an important observation if verified.

Dr. R. H. Ward described a couple of neat contrivances, — one, a new illuminating arrangement called the iris illuminator; the other, a long-armed lens-holder. Prof. William A. Rogers gave a description of the various steps by which a centimetre or an inch may be produced from a standard metre or a standard yard respectively.

The remaining papers contained almost no new original matter, but were chiefly accounts of methods or apparatus well known to professional workers.

PROCEEDINGS OF THE SECTION OF ANTHROPOLOGY.

THURSDAY forenoon was occupied by the general meeting, leaving only time for the organization of the sections. In the afternoon the address of the vice-president, Prof. E. S. Morse, was delivered to a very attentive and interested audience. As we have already given this address in abstract, no analysis need be added here.

The real work of the section began on Friday morning, with a paper by Rev. S. D. Peet, upon emblematic mounds, their uses and purposes. The author, having carefully studied many of the mounds, has reached the conclusion that from them much may be learned as to the symbolism of the people who made them, and through this of the people themselves. He thinks that certain animal forms were used for specific localities. For example, turtle mounds were placed upon high ground where a lookout would be stationed; eagle mounds, near bluffs; panther mounds stood guard over village sites. He believes that the mounds indicate the totems of the tribe which made them. The paper was illustrated by charts, and was followed by an extended discussion. Many of the archeologists present were evidently unable to identify some of Mr. Peet's mounds, as represented in his diagrams, with known animals, so confidently as he did; and some of the outlines seemed quite unlike those of any animal, though of most the animal form was evident. The discussion soon turned upon symbolism in general. Mr. La Fléche, an Omaha Indian, and member of the section, spoke of some of the symbols common among his people. Dr. Syle of China referred to similar symbols common among the Japanese and Chinese, and noticed the very remarkable resemblance which existed between current symbols in eastern Asia and western America. Dr. E. B. Tylor spoke of the totem system as wide spread, being found not only in North America, but as well in South America, Micronesia, and among the hill tribes of India.

Then came a paper by Miss A. C. Fletcher, upon child-life among the Omahas. It was such an account as only one who had lived among the people, and with hearty sympathy entered into their daily lives, could have given; and the earnest, clear, tender treatment of the subject was most delightful. We were told how, when ten days old, the child received a sacred name given with impressive ceremonies; how its cradle was prepared, and how lovingly the little one was tended, often by father as well as mother. This cradle is a flat board, to which the child, laid on its back, is swathed; the bandages for girls being different from those used for boys. Because of this treatment, most Indians exhibit a peculiar flattening of the occiput. The child is not kept constantly on the board, but at times is allowed to kick about at will; and after the sixth month it is rarely used, a hammock then taking its place. The crying of the child seems very unpleasant to them, and if it occur they use every means to quiet it. When the child is three years old, the solemn ceremony of cutting its hair generally takes place, though all the children do not receive this. Before this, the hair is allowed to grow. At this time, if the parents desire, a new name may be given to the child. Each gens has its own style according to which the hair is cut. The home life of Omaha children was shown to be pleasant and joyous, and the child is very much attached to it. Toys, games, and story-telling abound. After early childhood has passed, various duties are assigned to the children, — to the boys, the care of the ponies, the use of the bow and arrow, etc.; to the girls, the care of younger children, and later tilling the ground, dressing skins, and cooking, and until a girl is profi-

cient in all these things she is not regarded as fit for marriage, which occurs when she is about twenty. At the conclusion of the paper, which Dr. Tylor called 'most tantalizing,' many questions were asked, and in response to these many additional facts were given. That great respect for woman prevailed among the Omahas, was emphatically asserted by Miss Fletcher. Articles of taboo were common; each gens having a certain group of objects which must not, on any account, be touched. Dreams play a very important part in an Indian's life: to him, dreams are as real as any part of the actual world about him. Mrs. Smith spoke of a custom among the Iroquois, of placing near the mouth of the dead baby when buried a cloth saturated with the mother's milk. Friday afternoon's reading began with a paper by Miss F. E. Babbitt, describing certain very rude quartz objects found *in situ* in undisturbed gravel-banks in central Minnesota. Dr. Abbott, in connection with this paper, described and exhibited some of the objects found by him in the Trenton gravels. In the next paper, Rev. S. D. Peet endeavored to show the importance of a study of the architecture of prehistoric nations as a means of discovering their degree of civilization, and subdividing the stages of progress.

A much-neglected and yet not unimportant department of ethnology was brought before the section in a paper by Mr. A. W. Butler, on local weather-lore, in which he presented a collection of sayings respecting the weather, current in southern Indiana, excluding all that are of more wide-spread use. The last paper of the afternoon, by Mr. A. E. Douglass, described in a very complete manner some of the mounds of the Atlantic coast of Florida which the author had explored. Both shell and earth mounds are found quite evenly distributed along the coast from the mouth of the St. John's River to the southern part of Lake North. The shell mounds are for the most part situated upon narrow strips of land which separate the numerous lagoons from the sea. Some are of great size: one shell ridge is eight miles long; and one mound, which covered three acres, was made up entirely of the little shells of Donax variabilis. These large mounds were constructed at different times. The earth mounds occur inland. Two of the mounds are composed wholly of bits of rock; and one large mound has, three feet below the surface, a pavement of stone which extends entirely across it. Implements and other objects are often found in the mounds of the St. John's River, but not in the more southern mounds. Mr. Douglass's account was quite detailed, and a very interesting and valuable addition to our knowledge of the subject.

On Monday morning the section first listened to a paper by Mrs. Erminnie A. Smith, on disputed points concerning Iroquois pronouns. She spoke of the peculiar difficulties which arose from the manner in which the pronouns were used in Iroquois, — some of them being arbitrarily used; different words sometimes requiring unlike pronouns for the same person and number; and there were other peculiarities which had misled students of the language. Another difficulty and source of error was found in the use of gender. The early writers recognized but two genders, a noble and an ignoble; while the author had found three, as in English. Some of the pronouns, as that of the third person, answering to our 'he, she, it,' are always incorporated; while others, as indeterminate pronouns, are always expressed independently. The grammar of Père Marcoux was criticised by the author, and certain errors pointed out. Dr. Tylor remarked, in connection with this paper, upon the importance of studying the treatment of gender in any savage language with great care. Not all peoples recognize the division of living or other objects into male, female, and neuter. The Zulus have many classes, or genera, into one or another of which any given object falls; but they do not make any distinction of male and female. Miss Fletcher said that among the Sioux the same pronoun was used for both sexes, the gender being determined by the context.

A very long and extremely interesting account was then given by Mr. F. W. Putnam, of the explorations which he and Dr. Metz had carried on under the auspices of the Peabody museum at Cambridge. These investigations had been chiefly devoted to the study of a group of mounds near Madisonville, Ind., known as the Turner group. The very careful manner in which the exploration of the mounds had been carried on — the earth taken away and examined shovelful by shovelful — was shown, and the results of the work enumerated and illustrated by diagrams and photographs in great number. Neither time, labor, nor money had been spared in the prosecution of the work; and as a result one of the most remarkable series of objects ever discovered in America had been obtained, and also many new facts respecting the structure of the mounds themselves. For example, it was found that in stratified mounds the layers were always horizontal, not, as usually represented, curved. Singular ash-pits, masses of burned clay, layers of stones, and other features were mentioned and illustrated. Among the objects taken from the largest mound of the group were the following, some of them never found before in the mounds: shell beads, disks, and rings, which were obtained in thousands; cones cut from alligator-teeth; ornaments cut from plates of buffalo-horn, mica, and native copper; objects of native silver, and even gold, and meteoric iron; pearls, most of them pierced, and injured by heat (not less than fifty thousand of these were found); small stone dishes beautifully carved to represent some animal form; and last, and perhaps most important, terra-cotta figurines of exceedingly artistic form, and strangely Egyptian in character. These objects, it should be noted, are all of an ornamental character: no other sort was found in this mound. A brief paper by Miss C. A. Studley described some of the crania from this mound, and others near it.

In the next paper, Dr. P. R. Hoy showed how grooved stone axes and similar implements could be manufactured by the use of a common hammer-stone, and showed specimens that had been so made by a friend. The specimens, which Dr. Hoy asserted

[ ]ere made without great labor, were certainly dan[ ]rous counterfeits, such as might readily be passed [ ] as genuine. Mr. Putnam remarked, after Dr. Hoy [ ]d finished, that many counterfeits were now manu[ ]ctured, and that they might be found in almost [ ]ery large collection, and he had knowledge of one [ ]ipment of two thousand of these frauds to England. [F]ollowing this was a paper by Major Powell, on the [my]thology of the Wintuns, a people living in the [Sac]ramento valley. Many curious myths collected [amo]ng this people by the author were given, but an [abst]ract of such a paper is hardly possible. A few [of t]he beliefs of this tribe may, however, be given. [They] believe in three worlds, and that each has its [pecu]liar class of inhabitants. The sky is smoke. [ ]r—and the majority of—Indians believe that [ ]ce, as snow and hail show, and rain is the same [ ]d; while a few think it quartz crystal.) Moun[tains] were made by the burrowing of the mole-god. [ ] and darkness are maiden goddesses. Rocks [and o]ther inanimate things were once living, and [the r]ocks now live and speak; and this is the Win[tun e]xplanation of echoes. Whirlwinds are little [ ] seeking water to drink. Diseases are caused [by myt]hical animals. The 'tar baby' of the negroes [ ] south appears in some form in the mythology [of no] less than fifty tribes of Indians; and other [ ]f negro folk-lore are also found among the [ ]s, from whom the slaves must have obtained [ ] Dr. W. H. Dall then read a paper on the use [of labr]ets, its title being 'The geographical distribu[tion of] labretifery.' He described labrets of differ[ent so]rts, and the mode in which they were worn. [The ex]tent of the custom over the continent was also [ ]l, and the fact that it is less prevalent now [than f]ormerly. The great size of some of the lab[rets wo]rn was mentioned.

[ ]day morning marked an epoch in the history [of the] section, because of the very thrilling and vivid [ ]t and exhibition of the sacred pipes of friend[ship]sed by the Omahas. The pipes themselves [are he]ld in such reverence by the Indians, that they [were ne]ver allowed to leave the tribe, and those [ ] the audience were the first ever taken away; [ ]e ceremonies described and illustrated had [never b]efore been presented to an audience of white [ ] Moreover, it was extremely interesting to [ ] full-blooded Indian explaining in clear, well[ ] sentences, some of the most sacred mys[teries o]f his tribe to an audience of anthropologists. [ ] Flèche first described the pipes, and how they [are m]ade,—the stem of ash, seven spans long, dec[orated] with certain feathers of the owl, woodpecker, [ ]nd duck, and with hair from the breast of the [ ] and streamers of horse-hair dyed red. The [ ]as painted green, and grooved by narrow [ ]t grooves; and, when the two pipes are in [ ] they rest upon a wildcat-skin at one end, [t]he other is supported by a crotched stick, and [ ]them are two gourd rattles which are shaken [acco]mpaniment to the song, or chant, sung when [ ]es are taken up and waved to and fro as they [ ]ing the ceremony. After Mr. La Flèche had given his paper, Miss Fletcher continued the account, showing how strong the tie of friendship formed in the presence of the pipes is,—stronger even than ties of blood; and that in their presence no anger or ill-will could have place, but all must be peace and harmony. She spoke of the miraculous power attributed to the pipes by the Indians. The stem was of ash, because that and the cedar were the two sacred trees; the ash being associated with that which is good, and the cedar with that which is bad. With deep pathos she described the ceremony which took place when the pipes were given to her to bring away, and explained that it was only because of their profound gratitude to her for securing their lands to them from the government, that this mark of their great confidence and esteem was bestowed upon her by the Omahas. No account can justly describe the character of this joint paper. It was constantly illustrated by reference to the sacred objects exhibited, and afforded those who heard it a most vivid and intensely interesting insight into the hidden mysteries of Indian life and character.

Following this was a very instructive paper by Prof. E. S. Morse, giving some of the results of extended interviews with a Korean. Many interesting facts respecting this little-known people were given. The author spoke of the great filial obedience and devotion of the sons, the secluded position of women, the system of serfs; the law forbidding all except the king from decorating the exterior of their houses, or having any other than rectangular openings for doors or windows. The bride and groom never see each other before marriage. There is a general tendency to indolence. Strangely, a horse-shoe is a sign of good luck. Their games are numerous, and some of them intricate. Many of the superstitions of the Koreans were given.

After this, Dr. Tylor spoke upon North-American races and civilization. He alluded to the wonderful resemblance of our North-American tribes to Mongolian peoples,—a resemblance suggesting at once, not an indigenous origin for the Indian tribes, but a migration from Asia across Bering Strait. The greatest objection to this view is found in the very great diversity in the languages of the American nations. This leads to an examination of the evidences of the antiquity of man upon this continent; for, unless we can prove an antiquity sufficiently remote to allow time for the strange diversity of tongues to have occurred, our perplexity is great. While there is this diversity of language, there is great similarity in the social condition. The matriarchal system (descent, etc., through the mother, not the father) is universally prevalent.

A most thoughtful and able paper was then read by Major Powell, on three culture periods,—savagery, barbarism, and civilization. The evolution of man was dwelt upon very earnestly by the speaker. He very emphatically, and almost indignantly, expressed his belief that man's evolution never is nor can be a struggle for existence. Man does not change with change of environment; he changes, and adapts his environment to himself. The struggle has been

removed from man to his activities. Man progresses, not by struggling for existence, but by means of his pursuit of happiness. Animals live each for itself: man cannot live for himself alone. When animals were domesticated, a great step in advance was taken. By this means, and by the introduction of agriculture, the gens was broken up, and the matriarchal system changed to a patriarchal. Another great step was taken when metallurgical processes were discovered; then civilization was reached. Owing to the lateness of the hour, Major Powell omitted a large part of his most interesting paper. Speaking, as he did, with the earnestness of intense conviction, he bore his audience from argument to argument in a masterly manner; and many warm expressions of approval were bestowed upon the author.

The opening paper on Wednesday morning, by Mrs. Erminnie Smith, discussed in a very original manner the formation of Iroquois words. She very pertinently called attention to the fact, that most students of Iroquois had contented themselves with collating lists of words, while the more thorough and useful method would involve a search for roots by analyzing words; and the author had proceeded in this way, and as a result made many curious discoveries. Certain errors in dictionaries of the language were pointed out. The Tuscarora language, she thinks, affords a key to the dialects of the other six nations. Examples illustrating the formation and origin of many words were given. The literal meaning of many words in common use is very curious: for example, tears are, literally, eye-juice; whiskey, deformed water; agony, he eats up his life; a bank is a money-farm, — the principal is the mother, and the interest the baby. Birds are often named from their note, other animals from some physical peculiarity.

Following this was a long and most instructive paper by Dr. A. Graham Bell, upon a race of deaf-mutes in North America. Mr. Bell first called attention to the increasing prevalence of deaf-mutes in the United States. He showed that the increase of deaf-mutes was very much greater relatively than that of other classes. In order to open his argument, he asked the question, 'How can we in the most scientific manner establish a race of deaf-mutes?' In answer to this question, he showed that no more efficient means for the formation of such a race could be set in action than just those which, from the best of motives, philanthropy had used and was still using for the benefit (?) of these unfortunate people. The system of secluding deaf-mutes, so that they associated only with each other; teaching them a special language, so that they learn to think, not in English, but in a language as distinct from it as French or German, and thus lose largely their use of English, and cannot express themselves well in written English, — all this he strongly deprecated. He spoke of erroneous ideas respecting the deaf and dumb, which are more or less prevalent. In the education of deaf-mutes, Mr. Bell would follow a different course from that usually pursued. He would have this class of children educated in the constant company of children who can hear and speak, not reciting in the same

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called away. The address of Gen. Eaton upon scientific methods and scientific knowledge in common affairs was well received by an audience of about fifty persons. Some of the more interesting papers were the following: —

Prof. E. B. Elliott read a paper on the credit of the United-States Government, and presented tables and formulas. He said that the credit of the government had been continually increasing, as shown by the reduced rate of interest required; the rate of interest realized to investors in the four and a half per cents having been but about 2.7 per cent during the past four months.

Miss Alice C. Fletcher of the Peabody museum presented a paper on lands in severalty to Indians, illustrated by experiences with the Omaha tribe. She spoke of the Indians' ideas of land and property; of the agriculture of the Omahas, their reservation, their uneasiness upon the land tenure of Indians, and the desirability of securing to them land in severalty. The Indian question was discussed by Dr. Steiner, Mr. Spencer Borden, Mr. T. B. Browning, and others.

Mr. J. B. Martin of London read a paper upon the future of the United States; this, being from an English point of view, was very interesting. He called attention to the rapidity with which the public lands are being taken up, and to the rapid increase in population, which he thinks will soon reach seventy-five millions. How shall this population be fed? With the lands all taken up, and with cultivation brought up to a par with the improved agriculture of England, he estimated the surplus to suffice for thirty-five millions. The development of American agriculture will have to depend on foreign markets for its products; and, as the experience of England and America has been that food-supply is regulative of population, it may be assumed that Great Britain will long supply a market for cheap American food-products. But, meanwhile, the urban population is growing relatively to the country population; and this fact may be expected to exercise a retarding influence on the development of agriculture. The condition of the public debt was remarked upon as without parallel elsewhere. The debt charge has decreased to one-fifth the public revenue, while that of Great Britain is one-third the total revenue. With a debt entirely manageable, and with charges for naval and military purposes merely nominal, the nation will be able to develop itself under the most favorable conditions ever witnessed in the world. But the opportunity for capitalists to invest in public bonds failing, and the exceedingly low rate of interest, he regarded as ominous, and as likely to produce low wages, low prices generally, cheaper raw material, cheaper production, and close competition. The impossibility of spending the national revenue will cause a reduction of customs duties. With increase of population, and diffusion of wealth, the accumulation of individual fortunes will become more difficult, 'corners' less frequent, and time be found for literature, science, and art. He anticipates a gradual federation of state rights, increased intercommunication, perpetual shifting of population from state to state, — all tending to a complete amalgamation in one federal republic.

Mr. Thomas Hampson of the bureau of education read a paper on the apprenticeship question and industrial schools. He maintained that the apprenticeship system does not provide an adequate supply of workmen, and that it cannot be modified so as to do so. He, therefore, would substitute scientific for literary studies in the common schools, and establish manual-labor schools everywhere. Mr. C. M. Woodward, principal of the St. Louis manual training-school, gave a full account of that institution, which had been exceedingly useful thus far. Mr. Spencer Borden, owner of a bleachery at Fall River, Mass., encouraged the proposition; saying that he had become dependent upon foreigners for foremen of his factory, much against his wishes. The discussion showed much sympathy with the plan, though very little for labor-industrial schools, the latter tending to speculation upon the work of the pupils.

Professor W. O. Atwater of Wesleyan university read a paper on percentages and costs of nutrients in foods, which elicited great interest. Of the different nutrients, protein is physiologically the most important, as it is pecuniarily the most expensive. Among the animal foods, those which rank as delicacies are the costliest. The protein in oysters costs from two to three dollars, and in salmon nearly six dollars, per pound; in beef, mutton, and pork, it varies from 108 to 48 cents; in shad, blue-fish, haddock, and halibut, about the same; while in cod and mackerel, it ranges from 67 to as low as 33 cents per pound. Salt cod and salt mackerel are nearly always, fresh cod and mackerel often, and even the choicer fish as blue-fish and shad, when abundant, cheaper sources of protein than any but the inferior kinds of meat. With the larger proportions of both refuse and water, the proportions of nutrients, though variable, are usually much less than in meats. Thus a sample of flounder contained 67 per cent of refuse, 28 of water, and only 5 per cent of nutritive substance; while the salmon averaged 23, the salt cod 22, and the salt mackerel 36, per cent of nutrients. The nutrients in meats ranged from 30 per cent in beef to 46 in mutton and 87½ in very fat pork. Canned fish compare very favorably with meats. Vegetable foods have generally less water and more nutrients than animal foods. Ordinary flour, meal, etc., contain from 85 to 90 per cent or more of nutritive material; but the nutritive value is not proportional to the quantity of nutrients, because the vegetable foods consist mostly of carbo-hydrates, starch, sugar, cellulose, etc., of inferior nutritive effect, and because their protein is less digestible than that of animal foods. Potatoes contain a large amount of water and extremely little protein or fats.

Prof. J. W. Chickering, jun., and Prof. J. C. Gordon of the National deaf-mute college, Washington, read papers upon the condition of deaf-mutes and deaf-mute instruction. Deaf-mutes average 1 in 1,500 of the world's population. In the United States there were 33,878 reported by the last census. Over 15,000 have received an education, and are engaged in the

ordinary pursuits of life, 12,000 are of school age, and from 1,000 to 2,000 are uneducated adults. There are fifty-eight schools and one college, for this class, in this country. The usefulness of the educated and the pitiful condition of the uneducated were described by Professor Chickering. Professor Gordon maintained, in opposition to the views of Dr. A. Graham Bell, that the complete education of those born deaf demands social knowledge, special training, and special methods which are not possible in common schools; while the literal co-education of those born deaf, with hearing children, is an admitted impossibility. Deaf children prepared by special instruction to join regular classes in common schools without detriment to themselves, or to their classmates, do not need common-school instruction, having incidentally accomplished the work of the common school in gaining this mastery of language. The advantages of association with hearing children in the public schools are largely illusory, the environment being substantially the same as that of all deaf children before leaving their families to enter special institutions. Parents and public-school teachers can readily qualify themselves to render valuable help to deaf-mutes by beginning their education, and supplying, as far as possible, the training corresponding to the material education of infants and the earlier part of the work of kindergarten and infant schools. No satisfactory plan has ever been found for supplying deaf classes, in public schools, with teachers having the special fitness, knowledge, and training requisite for the satisfactory education of those born deaf. Special institutions remain a necessity for the great majority of deaf children; and they show superior results with the greatest economy of time, money, and men, irrespective of method, system, or devices of instruction.

Mr. William Kent of New York read a paper on irregularity in railroad-building as a chief cause of recent business depressions, which he supported with statistics and diagrams. He proved some remarkable coincidences during four periods from 1860 to 1883, 1869 to 1873 and 1879 to 1883 having been periods of great activity in railroad-building. The paper was discussed by Mr. Loren Blodget of Philadelphia, Mr. James H. Kellogg of Troy, N.Y., Mr. J. R. Dodge, and Mr. E. T. Peters. It was not generally conceded that cause and effect had been proven. Mr. Blodget referred to similar irregularities in English rates of interest, and Mr. Dodge to similar irregularities in cereals produced. In 1873 and 1874 these fell off six hundred millions of bushels, and the price rose from forty to sixty-four cents.

Mr. P. H. Dudley described his dynagraph and track-inspection car, and many members visited the car at West Philadelphia. This is one of the greatest of the many recent inventions for the safety of the travelling public.

Mr. L. A. Smith of Washington pointed out the advantages of great expositions to consist in 1°. stimulating the development of material resources, 2°. the introduction of profitable industries, 3°. the improvement of manufactures, 4°. the increase of trade, 5°. the founding of institutions, 6°. the social development of the people, 7°. advancement of science, and 8°. the promotion of technical education.

Don Arturo de Marcoartu of Madrid spoke upon the commercial relations of the United States with Spain and her colonies. He showed the meagreness of the present trade, and urged the importance of a treaty which should increase it. A line of steamers from Vigo or Lisbon to Boston or Baltimore is needed. The Umbria could make the voyage in six days. He desires to see the tariffs arranged so as to allow the exportation all over the Spanish territory of the American cereals, bread, coal, wood, cattle, and meats, and some other products wanted by the Spanish colonies; and to allow at the same time, on the other hand, the importation into the American union of wines, spirits, molasses, sugar, fruits, salt, and other Spanish products required in the United States.

Mr. George F. Kunz of Tiffany & Co. read a valuable paper on the American pearl, describing its form, color, lustre, and giving a list of the important 'finds.' He estimated the yield from 1881 to 1884 at $17,500 worth.

Dr. Charles Warren, statistician of the U. S. bureau of education, read a paper on the learned professions and the public, 1870–1880. Deriving the number of persons engaged in law, medicine, and divinity, from the occupation tables of the census, he showed that the rate of increase for each profession during the decade was much greater than the rate of increase in the general population. He commented upon the marked increase in the number of clergymen of foreign birth, and the great increase in lawyers, particularly in states situated north of the Potomac and Ohio rivers. Admitting that the number of clergymen is within the control of the sects purely, and not subject to legal interference, he observed that there is precedent for considering lawyers as officers of the state, and eminent propriety in making physicians also unpaid state officers. When this is done, the qualifications will be under state control, and indirectly the supply can be limited to actual needs. In 1880 he believes there was a surplus of sixty-four thousand in these three professions, and that decisive measures should be taken to remedy it.

Mr. Smiley of the U. S. fish-commission illustrated what is doing by the government in fish-culture, by presenting tables illustrative of the California salmon-work. An average of 2,500,000 young were deposited in the McCloud River from 1873 to 1883. The average annual catch has increased, since propagation began, by 4,391,882 pounds. This increase is worth, as it comes from the water, $313,700 annually. The annual cost of propagation is $3,600, leaving a net profit of $310,100 annually.

The sessions were all well attended; the number of persons in attendance frequently reaching fifty, and on a few occasions seventy-five. The popular character of the subjects induced this, and also induced the local press to give of this section much fuller reports than it gave of any other. The section has improved very materially since its organization at Montreal in 1882.

SCIENCE.

FRIDAY, OCTOBER 10, 1884.

OMMENT AND CRITICISM.

ncient geographers drew their prime through the Island of Ferro. They n followed by the geographers of Ger- d eastern Europe; while the French heir time from the meridian of Paris, that meridian in their maps; and the Americans, and Dutch recognize the of Greenwich as that of zero longi- With all these prime meridians, and ot so much used, there naturally arises able confusion in comparing maps the different systems; and especially e case in navigation, where the reduc- n one system of meridians to another e made by men who little enjoy extra The idea of a universal prime meridi- gs to France; and as long ago as 1632, suggestion of Richelieu, Louis XIII. decree recognizing that of Ferro. r, to gratify the pride of Louis XIV., returned to the meridian of Paris. ne meridian may be universally recog- s the zero meridian, an international ce on a common prime meridian was o meet in Washington.

erious business of the conference was ced last week Thursday by the dis- of a resolution presented by Mr. rd, that the meridian of Greenwich e recommended for the common use tions. So far as the views of the con- ere developed in the debate, it does n that serious opposition will be made proposal on the part of any nation but The French conferees have made a opposition to a decision in favor of ticular meridian, evidently desiring to e question open as long as possible. ported that they take this ground in ce of positive instructions from their government not to agree to the meridian of Greenwich. The conference adjourned on Thursday until Monday of this week, when the discussion was resumed. Commander Sampson of the U. S. naval observatory, Professor Rutherford, the author of the resolution, Professor Abbe of the U. S. signal-service, Professor Adams, and Lieut.-Gen. Strachey of Great Britain, favored the resolution, and Mr. Janssen of France opposed it. Mr. Janssen argued in favor of the adoption of what he called 'a neutral meridian.' He suggested that the international prime meridian should run either through Bering Strait or one of the Azores. Without action, the conference adjourned, subject to the call of the chairman. We can hardly share the view, which has found expression in the public prints, that the failure of France to accede to the decision will render the results of the conference nugatory. If all other nations adopt a common meridian, France will suffer much more by having one for her own exclusive use than any other nations will suffer by her action. The use of French maps, charts, books, etc., will be rendered inconvenient to others, and their circulation will thus be interfered with.

Sir William Thomson's course of lectures at Johns Hopkins university has opened with every prospect of being a brilliant success. It would be difficult to find a case in which a lecturer on so abstruse a subject was greeted with so large and appreciative an audience as was collected in Baltimore to hear our distinguished visitor. It comprised not only the advanced students at the university, but professors from various parts of the country, including even the far north-west, who had left their stations to hear the latest thoughts of mathematical science on the subjects of the constitution of matter and the ethereal medium. The subject of the first part of the course is the undulatory theory of light, the

difficulties of which the lecturer did not attempt to conceal. It is, however, expected that the lectures will cover the ground of molecular physics in general, including the theory of vortex atoms, of which the lecturer himself, is, perhaps more than any one else, the originator.

At the last session of congress, provision was made for an electrical commission, to be appointed by the president, and seventy-five hundred dollars appropriated for the work of the commission. The commission was appointed, numbering among its members some of the best electricians of our country. It was generally expected that the commission would make some electrical experiments or tests pertaining to dynamos and secondary batteries. We believe such was the intention of the commission; but the Franklin institute of Philadelphia announced its determination to conduct experiments upon both these subjects, and the commission probably deem it inexpedient to make experiments in similar lines. We would suggest, that there are other subjects of as great or greater general public interest, upon which experiments might be advantageously made. We refer to underground wires and induction. These are interesting scientific questions, and of vital importance to both public and private interests. There are many patents for the laying of underground wires and for the prevention of induction. It is peculiarly proper that the merits of these different inventions should be investigated by a commission of scientific electricians, as a great difference of opinion exists between city corporations, and the telegraph, electric-light, and telephone companies, as to the use of such wires; the former requiring that all wires should be run underground, the latter contending that there is no means now known for the successful use of underground wires extending any considerable distance. The questions of induction and 'leakage' are also most important, as every one knows who has listened to a telephone connected with one of our large city exchanges.

Microscopical science has been completely revolutionized by a series of inventions, which have followed one another by such slow graduation, that the result is far more noticeable than the progress of the advance, — we see the change, but not the changing. Thirty years ago, there was little to do about a microscopical preparation. The object was placed under the microscope, and looked at. Of technique, little was known beyond squeezing the object between slide and cover-glass to make it thin, giving a dose of acetic acid, and mounting in Canada balsam. To-day a vast variety of methods are in use, the gradual accumulation of the experience and experiments of numerous workers. The most delicate and fugitive phases of organization can now be caught and fixed; the softest and the hardest materials can be made to yield sections of the extremest thinness and consequent transparency; dyes are skilfully used so that the pattern of colors shows the distribution of parts of different constitution, and that which it is desired to see is marked out from its surroundings. Perfected microtomes, working automatically and driven by mechanical power, are made to cut an entire object into sections as thin as two thousand or three thousand to an inch, and keep every section in its proper place in the series. Indeed, the present perfection of the art of preparing objects for microscopical examination was unlooked for, a generation ago. Nevertheless, the progress here has been equalled by that in the microscope itself: the cameras and illuminating apparatus, the application of the spectroscope, of photographic and measuring devices, and of the electric light, etc., have immensely increased the efficiency of the modern instrument. Yet there is another improvement greater than any of these,—the introduction of oil immersion objectives. Although the progress we have hinted at has been enormous, it still continues more rapid than ever, as the well-filled pages of the new microscopical journal, referred to, in our notes this week, amply testify. Nothing is more remarkable than the rate of scientific progress to-day: men seem

in a fair way to be more amazed at their own intellectual production than at any thing that has yet happened in human history.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The Hall effect.

In your account of the proceedings of the section of physics, at the Philadelphia meeting of the American association, occurs the passage: "He [Mr. Hall] used not only gold-leaf, but strips of steel, tinfoil, and other metals, and clamped them sometimes at both ends, sometimes in the middle, and sometimes only at one end; and in all cases the action was the same, with the same metal, irrespective of the clamping."

This statement is not accurate. I have subjected soft steel only to the test here described, and I did not with this metal try the experiment of clamping it at one end only.

Again, it is not quite accurate to say that Mr. Bidwell attributes the action under discussion, to "one edge [of the metal strip] being compressed and the other stretched." One can best understand Mr. Bidwell's explanation by examining the illustrations accompanying his article in the *Philosophical magazine* for April, 1884. E. H. HALL.

Cambridge, Sept. 20.

Iroquois pronouns.

Allow me to correct the entire misconception of my Montreal paper by your reporter of the anthropological section. I did not affirm that the "missionaries and all other authorities who have heretofore written on the Iroquois languages were mistaken," etc. On the contrary, I proved that my conclusions concerning the existence of an *it*, and the non-existence of *on*, were correct by quoting the 'exceptions' and so-called 'idioms' resorted to by the French missionaries to sustain their adaptation of the language to the French form of two genders, etc. This adaptation, which simplified the study for the young priests, I affirmed would be folly for us to follow when writing upon Iroquois construction for English students. I proved my position by numerous examples from the best native authority, from those who understood English or French as well as myself. I might remark here that such authority presents a vast contrast to that which the pioneer missionary could obtain, and greatly facilitates investigation. I could refer your reporter to 'vocabularies' by long-resident missionaries which to-day are worthless from this fact. As to the 'English missionaries' referred to, I know of none who have contributed to Iroquois grammar.

I mentioned Rev. Ashur Wright, an American, as recognizing three genders; also Hon. Lewis Morgan, author of the 'League of the Iroquois.'

Upon so-called 'hazardous assertions' depends the march of science, and I venture to re-assert, '*it* still moves.' ERMINNIE A. SMITH.

Jersey City, Oct. 1.

Classification of Mollusca.

In Professor Gill's instructive comment on molluscan classification, he unintentionally misquotes me. The review in question said that no single instance of a calcified jaw 'occurs *to us*,' the two words in italics (omitted by Professor Gill) making all the difference between a positive assertion and a provisional one. The Nautilus, as Owen, Lankester, and others state, has been regarded as having a calcified jaw; and I am quite confident that it is the single instance known among recent mollusks. However, there is reason to believe that the expression of Owen was used in a less precise sense than has been supposed by later writers, and that the calcification, if actually present, is at most partial, and perhaps a mere individual trait. In the only specimen of Nautilus I have had the good fortune to be able to examine, the visible parts of the jaw were wholly free from any calcification. Whether the portions embedded in the muscular tissue, or otherwise hidden from view, may have been calcified, could not be determined, the specimen being held too precious to dissect. The composition of the jaw of Spirula is entirely like that of ordinary cuttles, as far as the eye could determine; and it is evidently desirable that we should have further investigation in regard to that of Nautilus.

In regard to the Acephala, it does not seem to me necessary that they should be ordinarily divided, unless good ordinal characters can be found; and, if the characters now used are imperfect, there is no reason for retaining the divisions founded on them, except in a provisional sense.

I fully agree with Professor Gill, that the present Dimyaria are not derived from the present Monomyaria; but whether both may not have had a monomyarian ancestor, it is still too early to decide, as it is (in a less degree) about the exact homologies of the shell glands in Chitons and ordinary gastropods, whose common characters seem to me largely adaptive.

It may be added, that while, so far as we know, Ovulum has a purely involute shell, Pedicularia, in its early stages, resembles a small Erato with a distinct spire. W. H. DALL.

U.S. national museum, Oct. 4.

The primitive Conocoryphean.

Your notice of Mr. G. F. Matthews's paper, read before the British association, though complimentary, gave no idea of the contents. Part of this communication was of exceptional importance. All accurate histories of the development of single animals are now thought well of; but Mr. Matthews has traced not only the transformations of the larval, but the characteristics of the adult period, and the transformations of old age. This author has also added the general history of the evolution of some of the most ancient groups of the trilobites, and shown that the changes they pass through correspond with the changes which the individuals of one of the groups, the Ctenocephalus Matthewsi, passed through during its growth. Opportunities for doing this sort of work are rare, and the men who do it still rarer.

ALPHEUS HYATT.

[It was impossible for us, in the brief space at command, in reporting promptly two scientific meetings of a week each in quick succession, to do justice to any paper. Many were altogether omitted. — ED.]

Book-postage in the United States.

In reference to your remarks on the expense of using libraries through the mails, allow me to point out that this expense is in America exactly double what it is, and has been for many years, in England, and even in Canada. The English and Canadian

rate of book-postage is one cent for four ounces: the American rate is one cent for two ounces. Surely there can be no good reason for such a restriction on the diffusion of literature in this country. Distant subscribers to circulating libraries and book-clubs in England are regularly supplied through the mails. Why cannot we have similar facilities here?

A. MELVILLE BELL.

Washington, D.C.

Systematic earthquake observation.

It will give me pleasure to join in any such systematic effort to secure the observation of earthquakes as is proposed in *Science*, iv. 334, and to provide, so far as practicable, for establishing seismometers, and making observations at this observatory.

EDWARD C. PICKERING.

Harvard college observatory,
Cambridge, Oct. 4.

Abnormal form of Trillium grandiflorum.

Early in June, 1883, I found at North Ferrisburg, Vt., a curious specimen of Trillium grandiflorum, — a species given to monstrosities, as every botanist knows. In this instance the petals were twenty-one in number, and pale green, edged with purple-pink, in color. I removed the plant to my garden; and in 1884 it displayed a blossom with eighteen petals and six sepals. The petals were deeper in color than before, and their general hue was pink rather than green. At neither time were there any traces of organs of fructification.

HENRY BALDWIN.

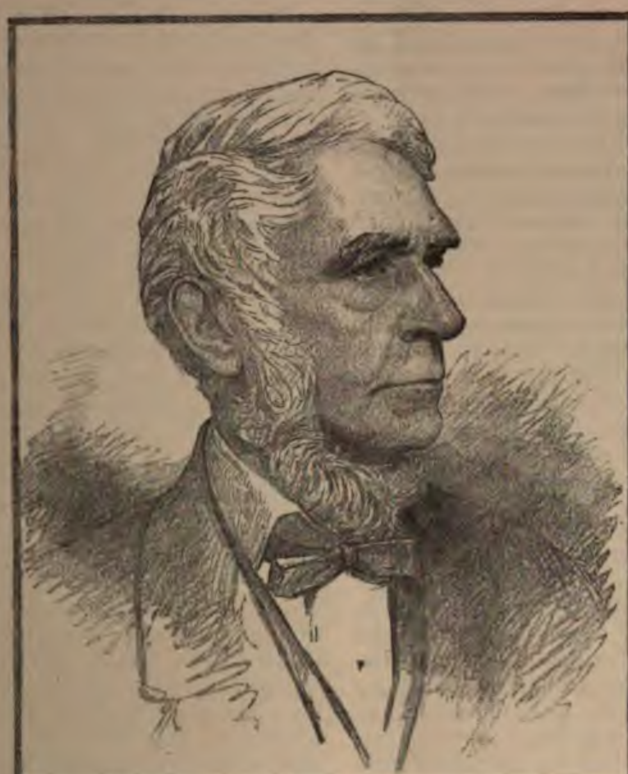
Charlotte, Vt., Oct. 3.

GEORGE BENTHAM.

GEORGE BENTHAM died at his house in London on the 10th of September, — a few days before the completion of his eighty-fourth year. The event is in the course of nature. His scientific life came to a close in the spring of the preceding year, when he laid down his pen upon the completion of the 'Genera plantarum.' His work finished, the wearied veteran succumbed to the bodily infirmities of age, yet still with mind essentially unimpaired, and has now gone to rest. His earliest publication bears the date of 1826, fifty-eight years ago. The first part of his classical monograph of the Labiatae was issued in 1832; and hardly a year of the subsequent half-century has passed without some botanical contribution from his hand. At the age of sixty, when most men seek retirement from service, he courageously entered upon his most formidable labors, — the 'Flora Australiensis,' in which he was assisted by Von Müller in Australia; and the 'Genera plantarum,' with Sir Joseph Hooker for his colleague, — and he lived to complete them both. Fortunately, he was able to devote all his time and powers to his favorite studies; and he steadily did so without distracting haste and without delaying intermission, for his short annual holidays were themselves usually made subservient to botanical investigation. Although he shunned official engagements and all time-consuming avocations, he did not refuse to bear his part of the burden in the administration of scientific affairs. When young, he was for ten years honorary secretary of the London horticultural society, with Lindley for under-secretary, in the most active and flourishing days of that institution. Later, he held for thirteen years the presidency of the Linnean society. In both situations he gave himself with characteristic thoroughness to his duties; he also brought to them a business tact, and a shrewdness of judgment and power of administration, which his very retiring habits would not lead one to expect. His annual addresses from the chair of the Linnean society, always pertinent to the time and the occasion, are models both in thought and in statement, and are of permanent value.

Mr. Bentham came of a notable stock. He was the nephew (and heir) of Jeremy Bentham; his father, Gen. Sir Samuel Bentham, was a naval engineer of remarkable talents; and his mother, if we mistake not, was a daughter of Dr. Fothergill. Some years of his boyhood were passed in Russia; the remainder of his youth in France, where his earliest botanical production was written and published. On his return to England he entered at Lincoln's Inn, and was admitted to the bar. About this time, to please his uncle, who had discerned his ability, he wrote a small and now very rare book upon logic, in which was first introduced the quantification of the predicate. But he soon returned to his early love, and devoted himself to phaenogamous systematic botany, in which, since his compeers, Brown, the elder Hooker, and Lindley have passed away, he has been *facile princeps*. His remarkable gift for languages, nearly every European tongue being at his command

was a great help: so, also, his independent but moderate fortune, free from family demands; for he was childless, and survived his wife. Of a philosophical temperament, and quite exempt from personal ambition, he might have been expected to take life easily; but *noblesse oblige* ruled his spirit, and he gave himself with unremitting and most disinterested devotion to his chosen line of work from boyhood to old age. He never seemed to select easy or congenial work, as he might have done, but rather took upon himself the harder tasks. Whatever he put his hand to was done faithfully; and, large as were his undertakings, he had the rare merit and good fortune of having completed all that he undertook. Hardly ever had a naturalist such a well-rounded life. Thirty years ago he gave to Kew his herbarium and library; and there, though living in London, he set up his study, in near association with his colleague and dearest friend, the director, in an apartment which will seem desolate enough now that he is gone. There he might be found at his work from ten to four o'clock during five or six days of every week 'with the regularity of a bank-clerk.' Neither biographical details nor an analysis of the work of Mr. Bentham are here attempted. These may be deferred to another occasion. But this simple tribute to a revered memory ought not to close without a word which may bring the reader nearer to the man. It might be thought that because Bentham was unusually reserved, and averse to popularity, he was of a cold and unsympathetic nature. It was not so. Rather, it was shyness, and a desire to save his time, that kept him aloof, and gave him an air of dryness. He was fond of the society of his intimate friends when the work of the day was over; and his attachments, if not numerous, were warm and true. All who really knew him will remember him as one of the most kindly, sweet-tempered, and generous-hearted of men.



George Bentham

The accompanying likeness, from one of the few photographs which were ever taken of him, represents Mr. Bentham at about the age of fourscore. A. G.

EDUCATION AT THE INTERNATIONAL HEALTH EXHIBITION, LONDON.

As a member of the general committee of this exhibition, as well as of the chief educational jury thereat, the present writer has been requested by the conductors of *Science* to give some account of the educational exhibits on

view there (several of which will, at its closing, be despatched to the New Orleans exhibition); as well as of the international conference on education, — the first ever held, — which was opened on Monday, Aug. 4.

The present exhibition (called the 'Healtheries') is on the site of the 'Fisheries' of last year; but more than two acres of additional buildings have had to be constructed for it, and portions of the Royal Albert hall, as well as of the newly erected City and guilds of London institute, have been pressed into the service also, mainly to afford room for some of the educational exhibits. It is probably not too much to say, that no such elaborate and extensive collection of educational appliances, methods, and results has ever been brought together before; notwithstanding the fact, that, the primary object of the whole exhibition being to elucidate the conditions of health, it was considered expedient to attach to the principal display, mainly such objects and appliances as had a special relation to healthful school life. This limitation, however, has been interpreted somewhat liberally; and the result is a collection in which can be studied and compared the educational systems in primary, general, and technical education as practised in the British Islands, France, and Belgium, and to a less extent in Germany, Sweden, Switzerland, the United States, and Canada. At a meeting of the jurors held early in June, at which the Prince of Wales presided, the eminent surgeon Sir James Paget delivered an admirable address on 'National health and work,' in the course of which he estimated (as the result of carefully compiled statistics) that the annual loss to the English nation from sickness, four-fifths of which was preventable, amounted to the work that twenty million men would do in a week. He also pointed out the close relations between education and health, and closed with a very eloquent aspiration for the creation of a sound public opinion that physical health, just as intellectual superiority and martial prowess, was a thing to be striven after.

The exhibition itself has been a very great success; the attendance having been about one-third more than at the Fisheries, and averaging about one hundred and forty thousand visitors per week. The musical attractions have been great, as well as those of the illuminations of the grounds and buildings. The electric-lighting display is on a much larger scale than on any previous occasion, many thousands of incandescent and hundreds of arc lamps being employed; and the perfect steadiness of the latter exceeds any thing that has yet been seen. At the weekly Wednesday-evening *fêtes* the effects obtained by the illumination of fountains by electric lights in various ways (a prominent one being the total reflection of a beam of light within a jet of water, on the principle of the well-known lecture experiment) are exceptionally beautiful, and perhaps can best be compared to showers of various-colored gems.

The educational portion of the exhibition was opened by the Prince of Wales, about the middle of June; and its contents form the subject of a closely printed catalogue of several hundred pages, some of which are filled with admirable summaries and digests of the work accomplished by various educational organizations, — such, for example, as those of the ministers of public instruction in France and Belgium, both of which governments have organized elaborate collective exhibitions showing the methods and results of their primary and secondary education. Education in France has lately made most rapid advances; for the money which no previous government could obtain for popular education, the parliament of the third republic, definitely consolidated in 1877, has not feared to demand of the state, notwithstanding the pressure of taxes from the foreign and civil wars of 1870. In 1882–83 there were 5,432,151 pupils, and 129,657 teachers (of whom only 21,781 were uncertificated), in primary schools in France; and the general outlay of the state for primary education in that year amounted to very nearly $20,-000,000. In March, 1882, laws were passed which rendered obligatory, 1°. the teaching of the elementary physical sciences in primary schools, 2°. the performance therein of a certain amount of manual work. Accordingly we find exhibited by the French minister of public instruction the authorized collections of objects and apparatus used in this teaching, as well as models of simple and cheap apparatus such as could be fabricated by the pupils themselves. The second law has called into existence the 'École normale de travail manuel,' a school probably unique, in which the whole instruction is gratuitous, admission being by competitive examination; and its course comprises the systematic teaching of carpentry, the use of the lathe, the chemical and physical laboratory, the smith's forge, and the engineer's shop. The handicraft work of pupils in many of the French primary schools, as well as in several technical schools, is very remarkable; while in the department of agricultural industry, the work of schools at Lille,

and also at Beauvais, is much to be commended and worthy of imitation. In the Belgian court, the systematic methods and good gradation of the school work are very remarkable; and very great prominence is given to the objective method of teaching in almost every subject. The technological and other school museums (notably that at Verviers) the contents of which are collected by the pupils, deserve especial notice, as also the whole apparatus for handicraft teaching.

The collective exhibit of the Institute of the brothers of the christian schools (which will be sent *en masse* to New Orleans) is one of the most remarkable and interesting in the whole Educational exhibition. Founded in Paris in 1680 by the venerable Dr. J. B. de la Salle, the institute has now nearly 12,000 brothers, distributed over 13 countries, directing 1,200 schools with an attendance of about 330,000 boys. Following everywhere the same general methods of teaching, they modify their details according to the requirements of the country in which they are; for example, in their United-States schools, every boy is taught, 1°. shorthand writing, 2°. the Morse alphabet, 3°. the use of the type-writer. The results of their teaching, as exhibited in 'sworn' performances of their pupils, in some instances excelled any thing known to the jury of experts who reported thereon. One of their specialties is their system of models, maps, etc., for teaching geography: they were the first hypsometrical maps published in French, or, for school use, in any language; and they are intended to give, by a suitable arrangement of colors, clear notions of the real configuration of the earth's surface. The objective and demonstrative methods of teaching are slowly finding their way into English schools, especially the 'board-schools' of Birmingham, Liverpool, Leeds, etc. But it may perhaps be permitted to the writer to say, as the result of a very close examination (extending over more than a week continuously) of the exhibits relating to primary education in various countries, that one important lesson to be learnt from the comparison of continental methods of instruction with English (and, so far as his knowledge extends, the same remark applies to America) is the great advantage afforded by that objective system, and by the adoption of that systematic order and method in all subjects of instruction, literary or otherwise, to which the name scientific, in the highest and best sense of the term, is applicable. This system is really a continuation of nature's method of instruction, and should be commenced in the earliest years. The late Dr. Whewell, in congratulating a friend, famous for his knowledge and ability, on the birth of a son, remarked, 'Young as he is, he will learn more than you in the next twelve months!' Accordingly we find in this exhibition, that the increased attention now being devoted to the whole subject of infant training, and the enlarged sympathy and interest with which the best modern teachers are studying the methods of Fröbel (some of the developments of which are at the basis of all so-called technical training), have justified the appropriation of a very considerable space to illustrations of the methods and results of the kindergarten system.

The limits at our disposal permit of no more than a reference to the appliances and results of technical schools, and of elementary art-instruction, nor to special methods and apparatus used in educating the blind and the deaf and dumb, nor to exhibits which illustrate such important subjects as every thing relating to the structural arrangements of school-buildings, school-kitchens, sanitaria, school-infirmaries, and lastly, though by no means least in importance, the gymnastic and other apparatus for physical training in schools. An allusion may be perhaps expected to the controversy now going on in England about overwork in schools. Probably the best answer to the alleged overwork is the fact, given on the authority of Sir Lyon Playfair, that, in the ten years succeeding the passing of the compulsory-education act, the health of children between five and fourteen years of age was thirty-three per cent better (as evidenced by the death-rate) than in the previous ten years; while the health of children under five years old only improved five per cent in the same period. Investigation has shown that almost every case of over-strain occurs in poor districts (both in town and country), where the children are underfed, a piece of bread being often their only midday meal.

It has been the aim of the writer, to draw attention to the growing recognition of the importance of objective methods of teaching. This may almost be said to have been the key-note of the International conference on education (Aug. 4 to 9 inclusive), which the president, Lord Reay, the rector of the University of St. Andrews, struck in his opening address. In a very able and scholarly discourse, he traversed a very wide educational area; but the point which drew forth the greatest applause was the expression, in regard to primary education, of his hope that the reign of the three R's (reading, (w)riting, and (a)rithmetic)

would speedily be replaced by that of the three D's, — drill, drawing, and (a)droitness. At the close, Mr. J. R. Lowell, the American minister, speaking as an ex-professor of Harvard, moved a vote of thanks; which was seconded (in French) by Mr. Buisson, director of primary education in France. Mr. Auguste Couvreur of Belgium supported the motion; thanking also Lord Carlingford and Mr. Mundella, the English government representatives of the education department, for their presence there that day. There were about fifty foreign delegates from twelve countries (including Japan and Brazil), attending this conference, the proceedings of which will be published in the course of the autumn. The conference, after being opened by Lord Reay, divided itself into four sections, which sat simultaneously from ten to one and from two to five for five days; and we conclude this article with a list of some of the more important subjects on which papers were read and discussed. 1°. The conditions of healthy education; 2°. Infant training and teaching; 3°. Technical teaching of all kinds (by Professor Woodward, St. Louis, U.S.A., among others); 4°. The methods of teaching the different branches of physical and natural science in elementary and other schools; 5°. The teaching of music; 6°. Museums, libraries, etc.; 7°. Training of teachers; 8°. Inspection and examination of schools; 9°. Organization of elementary education; 10°. Organization of intermediate and higher education; 11°. Organization of university education; 12°. On the teaching of agricultural science.

WILLIAM LANT CARPENTER.

RAILWAY-SIGNALS AT THE ELECTRICAL EXHIBITION.

AMONG the interesting features of the Electrical exhibition are the different systems of automatic electric railway-signals, designed to render collisions and wrecks impossible. One system, already in quite extensive use, is there illustrated in its application to the running of trains on the block system, on both single and double tracks, to the approaches of a crossing of two roads at the same grade, and to various combinations of switches and signals, whereby a signal cannot be set so as to 'clear' a train until the switch has first been turned in the proper direction, and by this very motion has automatically unlocked the signal-lever. If through any obstruction or failure in the connections the switch is not thrown clear over to its proper position, the automatic electric unlocking action will not respond, and the signal cannot be turned to let the train proceed. The application to a crossing of two roads at grade is very ingenious. The four approaches are guarded by switches, always left open when not in use; so that a runaway locomotive, or other destructive intruder, would be switched round upon a side curve, out of harm's way, as far as the crossing is concerned; and the signals are locked fast at 'danger' as long as these switches are open. Upon the approach of a train from any of the four directions, it announces itself in the signal-house while still at a considerable distance; and then, if the crossing is clear, and there is no previous announcement from either of the other three directions, the signal-man in his lookout-house turns a lever, which, by pneumatic action, closes the switch for the approaching train. This same lever-motion locks all the other switches open; so that the man could not, if he would, let any other train approach the crossing till this one had passed. If the switch closes safely, an automatic electric circuit unlocks the danger-signal lever for this one switch. The man then turns it, and then clears the track for the oncoming train, which can thus pass safely without stopping. If trains approach, meanwhile, from other directions, the danger-signals and open switches — which the signal-man himself cannot unlock till the train has passed the switch beyond the crossing, and automatically unlocked them — prevent any other train from getting to the crossing.

In running upon the block system, it is so arranged that a train entering upon each section, automatically closes there a green warning-signal and a red danger-signal for any following train. As it leaves the section, it automatically signals back, and opens the red danger-signal, but leaves the green warning-signal till it has left the next section, two blocks ahead. The action of a train, then, in leaving one section and entering on another, is to set the two signals there, and to signal back one block to open the red signal, and two blocks to open the green. The engineer of a following train, upon seeing a green signal, will know that a train is somewhere on the section next but one ahead of him, and will run cautiously; and if, upon reaching the next signal, he finds both the green and the red, he must stop till the train ahead has opened the red one. Upon a single-track road a similar set of signals is given, on the other side of the track, for two blocks ahead as well as behind the train. The automatic train-signals are all given through pairs of insulated rails, across which any pair of car-wheels will close an electric circuit; and they are so arranged, that, if the battery fails, the signal goes to danger through the action of gravity, and so remains till the trouble is remedied. This system depends principally, for safety, upon the watchfulness and certainty of the engineer in reading the signals correctly.

Another company exhibits a system which in some respects is superior to this in avoiding the danger from sleepy or inattentive engineers, or from the difficulty of reading the signals in stormy or foggy weather, and the trouble from batteries giving out or getting weak. Each locomotive carries its own battery in the shape of a dynamo, driven constantly by a small steam-en-

gine, whether the locomotive is at rest or running. One pole of the dynamo is connected to the locomotive, and the other to the tender, which is electrically insulated from the former except through this connection; and the circuit is normally completed through the rails on which the wheels of both are resting or running. In this circuit, within reach of the engineer, is a pair of coils whose armature is tightly held as long as the circuit is closed; but, when it is broken, the armature is drawn away, and opens the valve of a shrill whistle; and it stays away, though the circuit may close again and the whistle continues sounding, until the engineer reaches out and presses the armature up to the coils again, thus compelling his attention and voluntary action to stop the whistle. At any point or series of points in the line, where it is desired to signal to or from the approaching train, pairs of rails are inserted, electrically insulated from each other; so that, during the instant while the locomotive-wheels are on one pair and the tender-wheels on the other, the circuit will be broken and the alarm-whistle set going, unless these rails are otherwise connected.

They are thus connected by wires leading from the pairs of such rails ahead to any desired points, — to signal-stations, to switches, to drawbridges, to culverts, or bridges, or any part of the track or road-bed liable to be washed away or rendered dangerous. Thus, so long as the signal-man does not open this circuit, so long as the switch or drawbridge is not open, and the culvert, bridge, and road-bed are safe, the circuit keeps closed through these loops, the engineer gets no signal, and he runs on with confidence. But if any thing is wrong ahead, or if the man in the signal-tower wishes to signal the oncoming engineer, these loops will be open, the circuit will be broken, and the whistle set going till the engineer voluntarily stops it. Moreover, the instantaneous current sent from the dynamo over these loops when closed can signal the approach of a train, from as far as desired, to the signal-man at a crossing, to the train-despatcher, to the switch or bridge tender: in fact, to any points from one end of the line to the other the continuous flashes of this dynamo-current can be made a perfect tell-tale of the progress of the train. Moreover, these same currents can be made to lock switches and drawbridges ahead of the approaching train from pairs of rails preceding the danger-signal ones; and the engineer can thus confidently approach such places at full speed, knowing that no careless or confused switchman or bridge-tender or evil-disposed train-wrecker can have thrown these open after he has passed the locking signal-rails, and then, from another pair of rails beyond, the dynamo unlocks them after the train has passed. A signal on the throttle-valve lever warns the engineer if he attempts to run out of the round-house without starting up the dynamo, and any subsequent failure in the dynamo also, of course, blows the warning-whistle till it is set right. This system, in which each locomotive is its own unfailing battery, has certainly important advantages, especially in compelling the attention and voluntary action of the engineer whenever danger is ahead.

THE COMMITTEE REPORTS OF THE AMERICAN ASSOCIATION.

Although several committees were discharged last year for making no report, there were no less than eleven to be called on at the session on Monday morning. Of these, six made no response whatever: others, only a verbal and partial statement. The following reports are of general interest: —

Dr. E. B. Elliott of Washington, the chairman of the committee on the registration of births, deaths, and marriages, said that this committee was created many years ago to petition the United States congress for the establishment of a system of registration of births, deaths, and marriages. Since many states have established systems of registration of their own, the committee has petitioned, not for a separate system, but for the co-operation of the general government in securing uniformity and efficiency in the several state systems.

The first report of the committee on stellar magnitudes (Proc. Amer. assoc., xxx. p. 1) included a plan for the determination of standards for stars fainter than the tenth magnitude. Twenty-four bright equatorial stars were chosen; and the standards were to be selected from the regions following them from two to six minutes of time, and not differing in declination from the leading stars by more than five minutes of arc. The second report presented this year consists of charts of all the stars visible with the fifteen-inch telescope used at the Harvard college observatory, in all but three of the regions from which the standards are to be selected. These observations have been verified by the fifteen-inch telescope of the Washburn observatory. The report was referred to the publication committee.

The committee to confer with committees of foreign associations for the advancement of science, with reference to an international convention of scientific associations, reported that they had succeeded in conferring with a like committee from the British association.

A motion to have the committee discharged, as it had completed its task, having been made, Prof. H. Carvill Lewis of Philadelphia asked whether the committee might not continue to be efficient in extending courtesies from our own association to kindred foreign associations. Many gentlemen felt that some steps should be taken whereby members of our association going to England may become members of the British association while there, and a like courtesy be extended to members of the British association while in America. He therefore suggested that the action on the motion to discharge the committee be deferred for the present, in the expectation that arrangements would be made for the holding of joint meetings by the two great associations.

Mr. Trelawney Saunders of London, Eng., said he should like to respond in a few words to the kindly sentiments that had been expressed from the platform. As an Englishman, he said that he was delighted to hear the sentiment — a general sentiment, he thought, or it would not have been ex-

pressed here — which had been uttered. "You came from us," said Mr. Saunders: "if you return to us, you will meet a welcome which has in it as much warmth as that which you have accorded to us. Upon all occasions, whether they be international or inter-scientific, I assure you that the American people, particularly the English-speaking American people, will find a cordial greeting on the part of any Englishman to whom they appeal."

The chair announced that the motion to discharge the committee had been withdrawn.

The only other response to the call for reports was made by Professor Young of the committee in relation to duty on scientific books. He said that the committee had prepared, and, he believed, had presented to congress, a bill on the subject stated, which had failed to reach congressional attention.

THE BOTANICAL CLUB OF THE AMERICAN ASSOCIATION.

The meeting of the American association last year at Minneapolis attracted a larger attendance of botanists than usual. Without much consultation, a meeting of those interested in botany was called, a president and a secretary were chosen, and discussions, short communications, and papers upon botanical subjects, listened to. The Botanical club was thus inaugurated; and before the close of the session it was decided to do what was possible to secure a larger attendance of botanists at the next gathering in Philadelphia.

Although during the interim the prospect of a good attendance at the Philadelphia meeting had been fair, the most sanguine were surprised to find, that, as early as Monday preceding the opening, a number of botanists had arrived in the city; and by the following day a larger gathering could have been assembled than the total attendance at Minneapolis.

The first meeting of the club, of which several were held between Friday and Wednesday, was responded to by an attendance of about thirty, — a little below the average attendance for the subsequent meetings. Prof. W. J. Beal of Lansing, Mich., the president, took the chair; and Prof. J. C. Arthur of Geneva, N.Y., was appointed secretary to fill the vacancy caused by the absence of Professor Coulter. A paper by Dr. N. L. Britton of New York, on the composition and distribution of the flora of New Jersey, was read. The surface-features of the state were given, and the corresponding vegetation described. The work of cataloguing the plants is being done under the supervision of the State geological survey. The list at present has reached the very large total of nearly fifty-five hundred.

Prof. C. R. Barnes of La Fayette, Ind., spoke of the course of the fibro-vascular bundles in the leaf-branches of Pinus sylvestris. The two needle-leaves at the end of each short lateral axis contain each a paired bundle. The question at issue was whether this structure represented one or a pair of bundles, or whether it might not be a segment of the fibro-vascular ring of the stem. A study of the early stages shows that the first change in the stem is to divide the fibro-vascular ring into halves at right angles to the plane of the leaves; and subsequently these divide again, sending one branch of each to each leaf. The paper led to much discussion by Professors Buckhout, Macloskie, and others.

Dr. Bessey of Ames, Io., described the opening of the flowers of Desmodium sessilifolium. They expand partially in the usual manner, then remain stationary till a particular sensitive spot at the base of the vexillum is touched by an insect, when the wings and keel descend with a jerk, the stamens are released, and the insect dusted with pollen.

Professor Mackloskie of Princeton, N.J., described the method of cross-fertilization of Geranium maculatum by bumblebees. Professor Dudley of Ithaca, N.Y., spoke of the torsion of stems of Eleocharis rostellata, and also on the protogynous character of some species of Myriophyllum. Mr. William H. Seaman of Washington, D.C., advocated the use of rather thick oblique sections in studying the structure of the fibro-vascular bundle, — a method that called forth a very strong protest.

Professor W. J. Beal gave a paper concerning the manner in which certain seeds bury themselves beneath the soil, which was discussed by Professors Bessey, Rothrock, and others. A paper by Prof. W. R. Lazenby of Columbus, O., on the prolificacy of certain weedy plants, embraced careful estimates of the average number of seeds produced by individual plants among various kinds of weeds. Dr. J. T. Rothrock of Philadelphia addressed the club on some phases of microscopic work, alluding particularly to micro-photography, its importance to the investigator, and the ease of execution.

Dr. Asa Gray called attention to the interesting discovery of Mr. Meehan regarding the mode of exposing the pollen in the common sunflower. He had found, that, contrary to the teachings of the text-books, the pistil and stamens develop together until reaching full length, when the filaments rapidly shorten, and the anther tube is retracted, exposing the style covered with pollen, the further changes being the same as usually stated. This Mr. Meehan construed to be a device for self-fertilization; while Dr. Gray showed, that, although bees carried pollen from one flower to another of the same head, they also carried it from head to head, which constituted crossing in the fullest sense. An interesting discussion followed, in which Professor Beal suggested that an excellent experiment would be to cover up the heads, and ascertain if any fertile seeds were produced. Dr. Gray thought it very likely there would; for, when cross-fertilization is not effected, self-fertilization often takes place. Mrs. Wolcott had proved this to be so; for, in covering up the flowers to keep birds away, she found that plenty of seeds were formed.

Dr. George Vasey of Washington gave some notes on the vegetation of the arid plains; which was followed by observations on the curvature of stems of conifers, by Dr. Bessey, in which he noted the bending of stems one, two, and even three years old.

Mr. Thomas Meehan discussed the relationship of Helianthus annuus and H. lenticularis; showing that there was a constant difference in the form of the corollas, the former being campanulate, and the latter tubular. The two are treated as one species in Gray's 'Synoptic flora of North America;' the one being considered a cultivated form of the other, — a view from which the speaker dissented. Mr. Meehan then spoke upon the fertilization of composites; concluding that the arrangements were such as to favor self-fertilization, which is opposed to the generally accepted view.

Prof. L. M. Underwood of Syracuse, N.Y., gave some statistics concerning the North-American Hepaticae. Of the two hundred and thirty-one species found north of Mexico, a hundred and twenty are peculiar to America: fully one-half the latter are not represented in any public or private herbarium in this country.

In a paper on the nature of gumming, or gummosis, in fruit-trees, Prof. J. C. Arthur detailed experiments from which the conclusion had been reached, that it was due to a de-organization of the cell-walls of the tree through the influence of some fungus, but not necessarily of a specific one. It had been produced experimentally by the bacteria of pear-blight and by Monilia fructigenum, the fruit-rot fungus; although the most common cause is doubtless the Coryneum, first described by Oudemans in Hedwigia.

At the final meeting the committee on postal matters then gave its report. This committee was appointed at Minneapolis to inquire into the various obstructions which the postal authorities throw in the way of exchanging specimens of dried plants. The efforts of the committee had been directed toward securing the passage of specimens bearing the customary written label at fourth-class rates of postage. The decision of the postmaster-general was read, stating that the present law could not be construed to permit the passage of specimens with written labels except at letter-rates, but expressing a willingness to bring the matter, at the proper time, to the attention of congress, the Canadian authorities, and the congress of the Universal postal union. Some discussion followed; and a motion was carried to continue the committee, and also instructing the president and secretary of the club to draft resolutions to be presented to the section of biology in order to still further promote the objects in view. These resolutions were acted upon by the biological section on the following day. Dr. Bessey was chosen president, and Professor Arthur secretary, for the next year.

Besides the reading of papers, the club took several excursions. On Saturday they went to the pine-barrens of New Jersey, about fifty participating. On Monday a party visited the ballast-grounds during the morning, and upon their return inspected the library and herbarium of Mr. I. C. Martindale of Camden, N.J. In the evening of the same day the Botanical section of the Philadelphia academy of sciences entertained the club, the Torrey botanical club of New-York City, and other invited guests, at the rooms of the academy. About three hundred were present, and a thoroughly enjoyable time experienced. On the afternoon of Tuesday the club and its friends, in all about eighty, made an excursion to the Bartram gardens, one of the most interesting historical spots to botanists in this country; and the club then adjourned.

In reviewing the attendance of botanists at Philadelphia, and the work of the Botanical club, there is much reason for congratulation. About a hundred entered their names on the register of the club as botanists, or about eight per cent of the total attendance, one-half of whom are widely known for their attainments in the science. There was no lack of interesting papers and free discussion. Besides the important measures already referred to, the club was instrumental in securing the appointment of a permanent committee of the Association to encourage researches on the health and diseases of plants. But, above all, the augmented facilities for intercourse and acquaintanceship, and the impulse imparted to individual workers, through the influence of the club, are a sufficient *raison d'être*, and a promise of usefulness for the future.

PSYCHICAL RESEARCH IN AMERICA.

A MEETING was held in Boston, on Sept. 23, to consider the advisability of forming an American society for psychical research. Prof. W. F. Barrett, vice-president of the English society, was present, and gave an account of the work they are doing in England in the investigation of 'mind-reading' and the so-called spiritualistic phenomena, which last they always find to fail when the medium is securely bound. As one good result of the English society's work, it was stated that there had been a decrease in the activity of the society of spiritualists in London. It was the sense of the meeting, that if any thing could be done in this country to check the growth of the belief in the supernatural powers of 'mediums,' and to show what is the true explanation of such phenomena as 'mind-reading' and mesmerism, it would be a work which should enlist the assistance of American scientific men. Professor Barrett showed, that, in the case of 'mind-reading,' most of the results pointed to an unconscious guidance on the part of the person whose mind was being read, but there were residual cases he would not so explain. It was the opinion of those present, that the collecting of the stories of fulfilled dreams and anxieties would be fruitless, but that there were many questions of a physiological nature which should be investigated, and no longer be allowed to go unanswered or ignored. A committee was appointed to consider the whole matter of the formation of a society, or in what way it may seem best to undertake the work; and, at a meeting held last week, steps were taken for the formation of a society in America, of which we hope soon to report the complete organization.

THE HÔTEL DES NEUCHÂTELOIS, AND WHAT BECAME OF IT.

AT a recent *fête* of the Swiss Alpine club, a despatch was received from Mr. Forel in regard to the names which he has found on the Aar glacier. Mr. Forel gave to the *Gazette de Lausanne* the following information on the subject. He recalled the scientific zeal of Agassiz and his friends in Neuchâtel, and their studies, extending from 1840 to 1846, of the glacier near Grimsel. These enthusiastic naturalists stationed themselves at the very centre of the glacier at the junction of its sources, — the Lauteraar and the Finsteraar, at the foot of the rocky promontory known as the Abschwung. They found on the middle moraine a block of micaceous schist, supported by other rocks, and forming a natural shelter, which they completed by other dry walls of rocks. They thus possessed a rustic cabin, which they named the Hôtel des Neuchâtelois; and there they lived three seasons, illustrious in the annals of science. From 1840 to 1843 the Hôtel was the rendezvous of all interested in the theory of glaciers. But unfortunately the block began to break up. As early as 1841 there were numerous fissures; and in 1844 it was broken into two pieces; since then, the frost has divided it into a thousand pieces. It is this *débris*, still of considerable size, which Mr. Forel has found. The highest block still bears inscriptions in red lead, unfortunately most of them illegible. He could only decipher the date '1842,' written three times, and the name 'Vogt' (at present professor at Geneva). Twenty-five metres lower, toward the valley, is the stone discovered by Mr. Ritter of Leipzig, which bears the inscription in large capitals, still easily read, "Stengell (engineer, pupil of Osterwald), 1844; Otz (engineer at Neuchâtel), 1845; Ch. Martins (professor at Montpellier);" and several illegible letters. This block also bears the inscription 'No. 2;' for in 1842, Agassiz had a number of remarkable rocks marked with numbers, the arrangement of which he intrusted to his friend Wild, the geodesist of the expedition. The block of the Hôtel was marked as No. 2. The third block is fifty-five metres lower, and bears the inscriptions, 'Solioz Auguste 1842,' 'Lieutenant Guntren,' and several words which Mr. Forel did not understand. Mr. Forel calls attention to the fact that the course traversed by the blocks since the determination of their position by Agassiz has been about fifty-five metres a year.

We add an illustration of the rock as it appeared in 1840–42, reduced from a plate in Dollfus's *Matériaux pour l'étude des glaciers*.

THE INHABITANTS OF THE PUNJAB.

Outlines of Punjáb ethnography: being extracts from the Punjáb census of 1881, treating of religion, language, and caste. By DENZIL CHARLES JELF IBBETSON, of her Majesty's Bengal civil service. Calcutta, *Government*, 1883. 4°.

THIS is an imperial quarto of about 375 pages, made up of portions of the census report, as indicated in the title, using no less than eight enumerations of pages in combining the stereotype plates selected. There is a good table of contents, but no general index.

The Punjáb has irregular boundaries; but it may be roughly indicated as that part of Hindostan north of the parallel of Delhi (near 28° latitude, and 78° longitude), and west of a line drawn north-west from that city,

which it includes. Kashmir, controlled by England, is not included in the report.

The Punjáb, with its feudatory states, covers an area of 142,449 square miles, with a population of 22,712,120. One-fourth of the Musalmán, one-twentieth of the Hindu, and eleven-twelfths of the Sikh subjects of England, and one-eleventh of the total population of the Indian empire, are in the Punjáb. This region was in the path of all the early migrations and expeditions into the Indian peninsula, and presents a fruitful field for the students of history, of languages, and of sociology.

Here are found the primitive forms of religion and of social customs, in near proximity to recent growths and modifications, while the intermediate steps are well represented. The early growth of property in land is well illustrated in the western part, while village communities are represented as typically perfect in the eastern part.

Abstract 1 includes the rainfall by tracts; and in notes appended, the general condition of the people, and the liability to famine, are indicated. The rainfall ranges from a minimum of an inch in the thinly populated western grazing-plains, to a maximum of a hundred and twenty-six inches in the Himalayan tract, where the moisture of the winds is precipitated by the mountains. A portion of the plains east of the meridian of Lahore (near 74°) yields good crops without irrigation, but is liable to disastrous failures that do not befall irrigated lands. It is the granary of the Punjáb, and has flourishing trade and manufactures.

Mr. Ibbetson says that all books with which he is acquainted .

"fail utterly and entirely in conveying to the reader the faintest idea of the religions which they describe, as actually practised by their million followers in the villages of the country. The books on Hinduism, for instance, describe Hinduism as it ought to be, Hinduism as it was, perhaps Hinduism as it now is among the Pandits and educated Bráhmans of the holy cities; but they do not describe Hinduism as it is in the daily life of the great mass of the population."

Recognizing his own knowledge as defective, he aims to point out where the esoteric doctrines may be found described for the various faiths in their purity, and, with these as a basis, to show how little they appear in the daily belief and practice of the Punjáb peasant, and to indicate what that belief and that practice are.

The Musalmáns are about one-half of the population; the Hindus, about three-sevenths; the Sikhs, about one-thirteenth; Jains, 42,678; Christians, 33,699; Buddhists, 3,251; and others in small numbers. The classifications of religions are unsatisfactory, in part from the unwillingness of the better part of those who profess a religion to acknowledge as of their creed the degraded classes who profess it, and partly from the difficulty of defining Hinduism in particular. No one is a Sikh by birth. Professed Christians, Jains, and Buddhists have a measurably defined position. Mahometanism approximates distinctiveness, but Hinduism is confusing. It is regarded as the outcome and expression of the character of its followers, rather than as an element influencing that character. In this census the Hindu was regarded as the normal faith of those not otherwise classified.

"Socially, the characteristic of the Hindu is quiet, contented thrift." The Sikhs are more independent, brave, and manly than the Hindus. The Punjáb villager, converted to Mahometanism, is invariably filled with false pride and conceit, and tends to become extravagant, unthrifty, and discontented.

There are few large towns in the Punjáb, and any attempt to identify the subdivisions by reference to a general map would be unsatisfactory.

Caste is very fully treated, and will be noticed at another time.

Brahmanism is given as the distinguishing feature of Hinduism, which early degenerated from a religion into a "sacerdotalism with Brahmans as its Levites, the vitality of which is preserved by the social institution of caste, and which may include all shades and diversities of religion native to India as distinct from the foreign importations of Christianity and Islám, and from the later outgrowths of Buddhism, . . . Sikhism, . . . and Jainism." The dead are worshipped. Superstitious observances are general. On the western frontier, Hindus are lax in ceremonial and caste observances. Hindu sects are innumerable, and liable to be returned as religions.

Sikhism is given as founded by Bába Nanák A.D. 1469–1539. Nanák did not attack the teachings of others, but added something higher, teaching that salvation came through repentance and a pure and righteous life. During his life, gentleness was predominant among his followers; but some of his successors becoming involved in politics, a Mahometan persecution arose against them, and a spirit of revenge was roused, emphasizing a martial spirit, especially under a guru, or leader, known as Govind Singh, A.D. 1675–1708. Among the formalities of the Sikhs was a baptismal

initiation, and a communion with consecrated cakes of sugar, flour, and butter; while caste distinctions were positively condemned.

It is only an exaggeration to say, that 'the language changes every ten miles:' but two-thirds of the people speak some form of Punjábi; one-fifth, some form of Hindi; one eleventh, Sindhi.

Abstract 63 shows that from 1875 to 1880, inclusive, fifty-six hundred and ten books were published in the Punjáb, only two hundred and twenty-seven of which were in English. This suggests what an extensive literature is yet to be brought to the knowledge of western scholars. An incidental reference indicates that Punjáb pupils learn the multiplication table to one hundred times one hundred.

The migrations and changes by which present conditions have been reached are treated in considerable detail.

This volume is a part of the record of the second effort to gain a complete census of the British dependencies throughout the world,— the first, indeed, which approximated full success. Its treatment of ethnic religions and social facts adds greatly to the available material for western sociologists. Mr. Ibbetson thinks the whole of the types of primitive superstitions in Tylor's 'Primitive culture,' so laboriously gathered from forgotten records, could be illustrated in current customs of Punjáb villages. In the omitted chapters there seems to have been an abstract of the population of all India, not easily restored by one on this side of the globe from diverse provincial reports. Abstract 45 gives the number of those in each ten thousand of the people professing each leading religion for each province of India, and other abstracts give kindred ratios to which one is desirous to add particulars. No summary shows the number of castes, nor are marriage statistics given. While superstitions are detailed for days under English names, we look in vain for a hint of the origin of the Indian Sunday. The complete report would make good some lack in this volume. The text, however, was prepared under great pressure for time, and there is a mass of material in official hands not utilized. There is such an amount of new information furnished, that defects of indexing or of arrangement are secondary, even when the printer sets a couple of pages wrong side up, and arranges tables so that one must often turn the book up side down to read sub-titles. There is, unfortunately, no uniformity in the spelling of oriental words by English officials. Among peculiar spellings here are Quran (the sacred book of Islám), Musalmán, Mughal or Mongol, Shekh, and Faqir.

GEOLOGICAL AND NATURAL-HISTORY SURVEY OF CANADA.

Reports of progress for 1880-82. ALFRED R. C. SELWYN, director. Montreal, *Dawson*, 1883. About 200 p., 12 pl., 9 maps. 8°.

THIS volume is one of the reports of progress of the Canada survey. Like all such preliminary reports of survey work, it is of a varied and somewhat scrappy nature. A report of progress must, in order to justify its name, have some of the valuable, if not diverting, qualities of a log-book.

There is no record of any final or definitely finished work in this account of varied and important labors. This absence of completed work in any part of the vast field of study before the survey will be apt to increase the friction which it now encounters. There is much to say in favor of the reconnoissance system, when a survey is charged with the exploration of such an imperial wilderness as the Dominion of Canada. Special considerations may, and often will, determine the elaborate study of particular districts; but the principal work should be, at least for years, the rapid study of the *areal* geology of the country, including the outlines of its commercial problems. This reconnoissance work seems fairly well carried on by the Canada survey. The reports lack the beauty of finish of the United-States publications; still, they represent the labor of devoted men, who are wrestling with bad food, swamps, and black flies for the most of their days in the field.

The first forty-five pages of this volume are occupied by the general report of the director. We note in it, that the notorious weather-prophet, Mr. Venner, who for many years was employed by the geological survey, had severed his connection with it. There is a good deal of tedious, and little valuable, detail in this synopsis of the survey work. Next we have a brief account of the system of geological nomenclature and map-coloring used by the survey. The system of coloring is convenient and sufficiently graphic; in the nomenclature, the author feels the need of the division Cambro-Silurian, a term that is now pretty well fixed in the science. The third paper, also by the director of the survey, is entitled 'Notes on the geology of the south-eastern portion of the Province of Quebec.' This interesting region contains the gold-bearing

gravels of the Chaudiere valley, which are among the few profitable placer grounds of eastern America. Although but a cursory examination, this study suggests many interesting points for future inquiry. Appended to this report are some notes on the microscopic structure of certain rocks of the Quebec group, by Mr. F. D. Adams. They seem to be careful studies; but, there being no figures of the sections from which the microscopic researches were made, they suggest little comment.

The first of the assistants' reports is that of Dr. G. M. Dawson, on the geology of the Bow and Belly river region, north-west territory. It contains a very interesting account of the coals of the Laramie epoch, which are of exceeding value to the north-western region. Although in its nature a preliminary report, it contains a large amount of valuable detailed information concerning these coals. Although essentially lignites, they are superior to the most of such deposits now in use in Europe. This report is illustrated by several rather coarse lithographs, showing interesting aspects of this district.

The next report is one by Dr. Robert Dell, on the geology of the basin of Moose River and Lake of the Woods, with two heliotypes of scenery, and two maps. This report is of a very preliminary nature. In its nine pages of text, only enough is given to show that the region is full of interesting problems. The accompanying maps show the general distribution of the Laurentian and Huronian rocks, but the information is only a matter of outlines. It has, however, a special economic interest, as it indicates a possibly new gold-field, and, what is perhaps of more importance, a prospect of extensive apatite deposits in this district. Appended to the report is a catalogue of plants and of coleopterous insects, the latter by the late Dr. LeConte. Next there are two considerable reports by Mr. R. W. Ellis, on the geology of northern and eastern New Brunswick, and the north side of the Bay of Chaleurs, and on the geology of the Gaspé peninsula. Both these reports concern very interesting regions, which have previously been described in a general way. In them a great many contributions are given to the general structural, as well as the economical geology, of these districts. There are interesting lists of fossils from the several members of the paleozoic series. We miss the detailed sections which are obtainable in this country, which would have greatly added to the value of the report.

Next there is a report on some of the mines of the Province of Quebec, by Charles W. Willemott. Except the apatite mines of the Gatineau district, these deposits do not seem to have much value. For the apatite deposit, there seems to be a large future. Accounts of the several mines are extremely brief, and have not much economic or scientific value. The volume ends with a report of Mr. G. Christian Hoffman, entitled "Chemical contributions to the geological survey of Canada, from the laboratory of the survey." It consists of about fifty determinations of various substances of presumed economic or scientific interest, with various remarks as to their value in the arts, only one of them of general interest; viz., a careful analysis of the mineral smarskite, newly found in Canada. This branch of the work of the survey has been put out of gear by the removal of the laboratory from Montreal to Ottawa. As a whole, these reports, covering as they do the work of three years, are rather disappointing. The survey has an annual grant of sixty thousand dollars. Much is to be allowed for the difficulties arising from the size and complications of the field with which it deals; still, it seems as if more in the way of definite economic and scientific results should be attained with this liberal expenditure.

NOTES AND NEWS.

WE take the following 'editorial note' from the September number of the *American meteorological journal* as suggesting a simple plan of work in which many non-professional observers might contribute a willing share toward the solution of important problems: "Is it not worth while to consider whether the deficiency of observations on local storms, which makes the determination of their action doubtful, could not be remedied by appointing special days on which hourly or bi-hourly observations should be taken, with additional records at still more frequent intervals when any change in the condition of the air required it? These special days might be on certain pre-arranged dates, 'term days,' so called, when the records would gather up any thing that happened to come along in the passage of the weather; but they would better serve the purpose here in view if they were really specially appointed by the signal-service officers only a day or two before their date. It is evident enough from an inspection of Finley's maps, and from a brief study of summer thunder-storms, that the southern side or south-eastern quadrant of our passing cyclones contains the greatest share of local disturbances. Let the plan be published in advance by circulars and newspaper paragraphs; and then, if, while a cyclone was still beyond the Rocky Moun-

tains, the day of its arrival over the upper lakes could be foretold, there might be thirty to sixty hours telegraphic notice given of the appointment of such a day for special observation over the whole region east of the Mississippi. The notice should properly take a somewhat striking form, so as to excite an interest in the attempt among persons who would ordinarily let the weather-changes pass by unnoticed; the newspapers and railroads could be in nearly all cases counted upon to aid in spreading the news of the appointment; and even if the general records gave only the direction and estimated force of the winds, and beginning and ending of rainfall, two or three special days of observation in June or July might produce a wonderful fund of material for study."

—Among the recently discovered petroleum-wells at Bakou, Russia, was one which for four or five days after opening threw a stream of oil into the air to a height of forty feet. The natives were so impressed that they built a temple especially for the veneration of the well. The wiser speculator has expended his energies in building a railroad from Bakou to Batoum on the Black Sea, and contemplates the construction of a canal fifty miles long, by which a river of oil may flow from the Caspian to the Black Sea. We reproduce from *Science et nature* an illustration showing the fountain of oil, copied from a photograph.

—Lieut. Stoney, U.S.N., commanding the U.S. exploring schooner Ounalaska, has been heard from under date of July 6, when he had reached latitude 66° 4′ north, and longitude 168° 15′ west. Upon leaving St. Michaels, Lieut. Stoney stood north along the American coast until June 27, when ice was encountered fifteen miles to the northward of Sledge Island, in latitude 64° 22′ north, longitude 166° 25′ west. After several unsuccessful attempts to penetrate the ice, which proved to be very heavy at this point, the Ounalaska was headed to the southward until clear water was reached, when the ice to the westward was skirted just to the north of St. Lawrence Islands, and St. Lawrence Bay was reached June 30. Learning that Kotzebue Sound was closed, Lieut. Stoney anchored, and waited for the ice to commence moving, and, after a four-days' gale from the south, he ran over and anchored under East Cape, where he remained, to take advantage of the first opening of Hotham Inlet, when the exploration of Putnam River would be continued.

—The Italian papers announce what appears to be an important discovery just made in Sicily. Petroleum has been 'struck' in the province of Palermo. A grotto in the flank of a mountain was pierced, and in twenty-four hours seventy pints were collected. The crude oil is said to be of very high quality, and is so limpid that it may be used with little or no refinement. The borings are being pushed forward very rapidly, and their results are looked forward to with no little interest. Hitherto, we believe, Italy has produced no mineral oil; and if, as seems likely, the new springs should prove productive on a large scale, the kingdom will possess an entirely new and important source of wealth. It should be added, that the present discovery is the result of a number of repeated but hitherto unsuccessful searches after petroleum.

—It has been announced at the hygienic congress held in August at the Hague, that the prize of two thousand francs, offered by the London society for the prevention of blindness, is awarded to Professor Ernest Fochs of Liége. The next hygienic congress will be held in Vienna.

—An interesting collection of antiquities from Cyprus is now on view in London. It includes beautiful specimens of ancient glass, some remains of pottery, a bronze mirror with a piece of the original cloth it was wrapped in, and some ancient armor. There are also some silk and cotton fabrics, such as are still made at Cyprus, some of which are both cheap and pretty. They are made on the simple hand-looms which are still used by the Cypriotes as in days of old.

— Dr. Ferd. Löwl, of the German university at Prag, has just completed a valuable *résumé* of observations and theories on the making of valleys (Ueber thalbildung, Dominicus, Prag, 1884, 136 p., with many cuts), that should prove of special value to American students of physical geology and geography. It will serve well as a guide to the German literature on the subject. The contrast is well brought out between the older theory that referred the beginning of valleys to splits and cracks in the earth's crust, and the newer that regards them as chiefly independent of these guides; and numerous examples are mentioned to show, that valleys are not only formed in unbroken rocks, but also, that, where the rocks are greatly faulted, the valleys run almost independent of the fault-lines. The origin of cross-valleys, on which the author had written previously (*Science*, i. 325), is again discussed, and carried to a conclusion adverse to that reached by Powell, Tietze, and Medlicott. The views of Rütimeyer and Stein, as to the revelation of old base-levels in the terraced slopes of Alpine valleys, are disputed chiefly because direct elevatory movement, by which the base-level is changed, is not any longer to be admitted in modern geology; and the cañons of the Colorado are referred chiefly to climatic conditions. While we cannot accept these conclusions, the book deserves careful study.

— The recent visit of Dr. C. V. Riley to Europe, on a mission from the Agricultural department, is noticed in a recent number of *Nature*, which says that during his two months' sojourn in Europe he has twice been on the continent, and has visited correspondents and acquaintances both there and in England, examining the insect collections in various museums, and especially at South Kensington. He speaks favorably of the lasting influence for good which the International forestry exhibition at Edinburgh will have, and of the Serrel serigraph, — an American invention, which has of late years been perfected in Lyons, and which he thinks is destined to revolutionize silk-reeling and profoundly influence silk-culture, which is just now attracting unusual attention in America. He was also much interested with the investigations into the life-habits of the Aphididae that are being carried on by Jules Lichtenstein at Montpellier, and with the thoroughness with which the French authorities encourage experimental research in advanced agriculture. He received a warm welcome at Montpellier, whither he went at the invitation of the French minister of agriculture to explain some new methods of dealing with the Phylloxera, and where he found his own recommendations of previous years so fully carried out. He was also surprised at the very extensive and successful experiments with American vines carried on at Pageset, near Nîmes. At a meeting of the Société d'agriculture d'Hérault, held on June 30, he read a paper entitled "Quelques mots sur les insecticides aux États-Unis, et proposition d'un nouveau remède," which appears in full, with an account of the discussion, etc., in *Le Messager agricole* for July 10, 1884. The 'new' remedy is kerosene emulsion, which has been successfully used, especially against Coccidae, in the United States. Its application against the Phylloxera is recommended in much the same manner as is used with regard to sulpho-carbonate of potassium. The proportions recommended are three hundred or four hundred grams of the emulsion in forty litres of water.

— A new feature in the German market is Caucasian petroleum. The first sixteen wagon-loads of petroleum by the Marienburg-Mlawbraer railway recently crossed the German frontier, and sixty more are to follow. The German-Russian naphtha-import company has acquired land on the frontier at Illowo, and here three reservoirs holding seventy-five wagon-loads each are set up; from these reservoirs the petroleum is to be pumped by steam-power into the German wagons.

— The mineral wealth of the Weser hills is becoming more clearly recognized in Germany. Ironstone beds have recently been found in several places, which seem to be connected and to form one long vein.

— Efforts to cultivate the tea-plant are now being made in several parts of Europe. In France, on the lower Loire, the plants have been extensively set; but it is still a question whether the leaves will retain their characteristic aroma on a foreign soil. In Sicily the plants set three years ago at Messina are strong and healthy, and have flourished in leaf and seed. Russia has also made the attempt, the first planting being at ten versts from Aleschbri on the Dnieper, and proving satisfactory; and plants have also been sent from Odessa to Suchum. In Germany the Silesian committee of agriculture have received seed and directions from Profe-sor Göppert of Breslau, with a recommendation to attempt their cultivation.

— The second part of the *Zeitschrift für wissenschaftliche mikroskopie*, etc., confirms our favorable opinion formed by the examination of the first number of the new journal, and we think the publication will soon become indispensable to active workers with the microscope. Microscopy is no longer the simple undertaking of a few years ago, but an art, manifold and elaborate in both its principles and its methods. Indeed, no one can be in the front rank of discovery in those fields where the microscope is the essential instrument of investigation, unless acquainted with the most recent advances of microscopical technique. The new Zeitschrift will be valuable, because it is to be the central repertorium for gathering and rendering accessible the improvements of the microscopist's art. We praise the periodical in question, because it does well what it undertakes to do.

We have to notice also another new journal, the *Recueil zoologique suisse*, comprising, according to title-page, "l'embryologie, l'anatomie et l'histologie comparées, la physiologie, l'éthnologie, la classification des animaux vivant ou fossiles." It is edited by Dr. Hermann Fol, with the collaboration of a number of his compatriots. It appears in parts of from a hundred to a hundred and fifty pages each, at irregular intervals. Four will form a volume of five or six hundred pages, with from twenty to twenty-five plates, in octavo. It is expected that the volumes will

be annual. The journal is published by H. Georg at Geneva. The price of the first volume has been fixed at twenty-five francs, but will be raised to forty francs as soon as completed. Three parts of the first volume have already appeared, and show by the character of their contents that the Recueil ranks from the start with the best of the zoölogical journals. Part third contains papers by Schiff on lymphatic hearts, Fol on a human embryo of 5.6 millimetres, Keller on Medusae, Sabatier on the cells of the follicle of tunicates, Flesch on a parasite of the horse, and Bedot on the central organ of Vellela. The plates and the typography are both excellent.

— Dr. C. C. Parry is now in England, examining the methods used in the care of European herbaria, and studying his favorite genera of plants as represented in the botanical storehouse at Kew.

— The hitherto rare shells, Helix facta and Binneia notabilis, have recently been found abundant on the volcanic island of Guadaloupe, off the Lower Californian coast, by G. W. Dunn. The curious Binneia, with a body much larger than its shell, envelops itself in aestivating in a case of material similar to the hibernacula of other land shells. The fauna and flora of this isolated island are largely southern Californian, rather than Mexican. Its beautiful cypress has been found near San Diego, its pine is Californian, while its palm is of a peculiar Lower Californian genus that extends to near the United-States boundary.

— The piece of the Calais-Dover cable shown by Mr. Crampton at the meeting of section D of the American association (see p. 324) was part of the cable laid thirty years ago, but was cut from the cable in 1859.

— Botanical collectors are active this season in developing the flora of unexplored portions of the south-west; paying especial attention to the rich fields of Arizona, New Mexico, and Sonora in old Mexico. The dry, desert fields of 1883 have been blossoming like the rose, and offering them unexcelled facilities.

— Baron Nordenskiöld has prepared for publication a volume containing all the results of his arctic work up to the present time; and an English translation of it will probably be published in the course of the present year. The rumor has been revived in the English papers, that his next important enterprise will be an expedition to the south pole; and it is certain that the question of the feasibility of such an exploit has been brought under his notice. Dr. Oscar Dickson has, however, informed his scientific friends in London, that he will have nothing to do with an antarctic expedition; but they are of opinion that he may reconsider his determination.

— A work on Lapland and the Lapps, similar in character to Mr. du Chaillu's 'Land of the midnight sun,' has been prepared by Dr. Trombolt, a Swedish *savant*, who some time ago visited that region to watch the aurora borealis. Dr. Trombolt lived in the closest intimacy with the Lapps; and the results of his observations, scientific and social, are about to be given both to the Swedish and to the English public, a translation of the work having been prepared by a Swedish gentleman resident in England, who is familiar with English.

— The French northern railway company has begun experiments on motive-power generated by electricity, at the Chapelle station. The company has established an electric lift with two Siemens electro-magnetic machines; one for elevating the weight, and the other for moving the machinery alongside the railway.

— Mr. G. F. Harrington, J. P., of Ryde, Isle of Wight, has tried a method of sewer-ventilation, by means of shafts placed at intervals of about five hundred feet, which are connected with the sewers, and carried up the sides of the adjoining houses. While one shaft conducts air into the sewer, the other carries it away. The in-draught shaft is surmounted by a cowl, which is so designed as to have its face constantly presented to the wind, and through this a stream of air is said to be always passing into the sewer; the return-shaft being open at a good height.

— Unfavorable reports have been received of the expedition of the Italian traveller Bianchi. He intended to work a direct way from Abyssinia to the Red Sea; but on reaching Mehallé at the end of March he was deserted by his escort, and obliged to return. After re-organizing his caravan he reached Danakil-land on April 30, and has since been reported as stopped between Lale and Zula by want of water; but the Italian government has received contradictions of this report from Aden and Assab.

— Dr. Richardson's experiments for the painless extinction of animal life have been brought to a successful termination. The electric shock did not prove sufficiently safe, so Dr. Richardson sought for an anaesthetic agent which would make death rapid as well as painless. He successively experimented with nitrous and carbonic oxides, ether, chloroform, coal-gas combined with chloroform, all of which more or less fulfilled their end. The results have been very satisfactory, as carried out at the London home for lost dogs, where a chamber was charged with carbonic oxide, the gas having been previously passed over a porous surface, from which it took up vapor containing chloroform. Into this chamber was introduced a cage containing the dogs, which in a very short time passed from life to death in a profound sleep, without evincing the slightest pain or consciousness. Dr. Richardson has also administered the same narcotizing agent to sheep, so as to allow of their being killed in a perfectly painless manner; and he hopes that before long there will not be an abattoir in England without facilities for employing the system.

— The Society of the red cross has instituted some experiments with the electric light as an aid in the search for wounded on the field. An exhibition of the experiment was made during the recent meeting of the society at Geneva, but proved a disappointment to the spectators on account of the full moon which was shining at the time.

SCIENCE.

FRIDAY, OCTOBER 17, 1884.

COMMENT AND CRITICISM.

We publish this week a chart of the circumpolar regions, showing the thirteen northern stations selected by the international commission for simultaneous observation in magnetic and meteorological phenomena, together with a brief statement of the work done at each. That fifteen arctic expeditions, comprising not less than two hundred men in all, should be sent out and return without loss of life attributable to the peculiar climate or conditions of the arctic regions, except in the one case where succor had not been provided as directed and expected, offers a suggestive lesson to those who, without examining the subject, are inveighing against the dangers of arctic research.

As the outcome of sexual selection, blue eyes are to disappear, at least from Europe. So predicts Mr. Alphonse de Candolle, in his paper on heredity in the color of the eyes in the human species, recently published in the *Archives des sciences*. In investigating the subject of heredity, it occurred to De Candolle that the color of the iris offered the best outward and visible sign. It is conspicuous; it cannot be masked by artifice; after early childhood it does not vary with age, as does the color of the hair; and the character is, on the whole, distinct. For, according to him, there are only two sorts, — black, or rather brown eyes, and blue; gray eyes being reckoned as mere varieties of the blue. From the working-up of the statistics, in part from series of observations made for the purpose, it appears, that, when both parents have eyes of the same color, 88.4 % of the children follow their parents in this feature; and, of the 11.6 % of children born with eyes of other than the parental color, a part must be attributed to atavism, that is, to intermittent heredity. But the curious fact comes out, that more females than males have black or brown eyes, in the proportion, say, of 49 to 45 or of 41 to 39. Next it appears, that, with different-colored eyes in the two parents, 53.9 % of the progeny followed the fathers in being dark-eyed, and 55.9 % followed their mothers in being dark-eyed. An increase of 5 % of dark-eyed in each generation of discolorous unions must tell heavily in the course of time. It would seem, that, unless specially bred by concolorous marriages, blue-eyed belles will be scarce in the millennium.

Apropos of the Bernhard Maimon collection of oriental antiquities, and of the Wolfe expedition to Chaldaea, it is instructive to note the growth of interest in Semitic study in America. The Semitic summer schools, under the inspiration of Dr. Harper and his co-laborers, attract from a hundred to a hundred and fifty students each year, chiefly, of course, for the study of Hebrew. The fact that Hebrew has been studied almost exclusively by candidates for the ministry has caused the language to be regarded as having only theological significance, and has obscured its scientific value. In some American institutions a change has taken place. At Harvard and at Johns Hopkins universities the chief interest in Semitic studies is intended to be a scientific interest. It is still true that most students who elect Hebrew expect to become ministers, but this is not the case with the kindred languages.

The remarks made in the Electrical conference at Philadelphia by Mr. Preece, the superintendent of the British postal telegraph and telephone system, upon storage-batteries, were especially interesting, both from his account of his successful use of the original Planté form in lighting his own residence, and from the refreshing frankness of his introductory remarks, in which he stated that there had

of spiritualism is protected by the utter mystery which screens certain mental and nervous conditions from the light of explanation. As of others, so the basis also of this superstition is, in one word, ignorance.

To those gifted with a clearer intelligence and purer moral sense, there is a moral duty in one aspect of the proposed studies. A hope that psychical research may liberate us from a baneful superstition is a stimulus to inaugurate the work of the American society; yet a scientific man cannot calculate all the after-effects of his labor, but must toil for the truth with blind devotion. It will be the endeavor of the new society to ascertain the truth in regard to the alleged psychical phenomena, by means of experiments of unquestionable accuracy, conducted with unprejudiced independence: it will try to steer safely between the Scylla of scoffing and the Charybdis of charlatan spiritualism.

The names of the present leaders of the movement in America are a sufficient guaranty that the investigations will be thorough and serious: we shall await their outcome with great interest, and we hope, meanwhile, that the society will receive liberal public support and encouragement.

THE INTERNATIONAL POLAR STATIONS.

Now that the result of the arctic sojourn of the various parties is determined, so far as concerns the safety of their *personnel*, and the manner in which they were able to carry out the programme of the international commission, it may be interesting for the readers of *Science* to briefly review the whole topic. Including Finland, ten countries participated in the work; namely, Germany, the United States, Denmark, Austria, Sweden, Norway, Russia, the Netherlands, Russian Finland, and France. Fifteen primary stations were contemplated, of which two in the southern, and twelve in the northern, hemisphere were successfully established, all of which, it is believed, carried out the observations prescribed by the commission. The several stations were as follows: —

1. Discovery Harbor, Lady Franklin Bay, established by the United States. The party consisted of Lieut. A. W. Greely, U.S.A., assisted by Lieuts. Kislingbury and Lockwood; astronomer Edward Israel; Octave Pavy, M.D., surgeon; two Eskimo hunters; four signal-corps observers, and fourteen petty officers and enlisted men. This expedition left St. John's, Newfoundland, July 7, 1881; arrived at Disco, July 17, and at their station, which was named Fort Conger, Aug. 12. The position of the station is approximately latitude 81° 20′, longitude 64° 58′ west of Greenwich. The Proteus, after landing the party and stores, sailed on her return about Aug. 26. Efforts were made to reach this station in 1882 by a party on the steamer Neptune, and in 1883 by one on the Proteus, but both failed in the attempt; nor was a suitably large supply of provisions landed for the support of a retreating party when opportunity offered. Aug. 9, 1883, the observations having been carried on successfully, the party in good condition retreated to the vicinity of Cape Sabine, finding an insufficient supply of provisions and no rescuing party. The melancholy result need not be recapitulated. Lieut. Greely and six men, one of whom afterward died, were rescued June 22, 1884, by the relief expedition under Capt. W. S. Schley, U.S.N., in the ships Thetis and Bear. The remainder perished of want and exposure, except one man shot for theft and mutiny, and one Eskimo accidentally drowned. The exact state of the records of this expedition has not been made public; but it is believed that the international programme was carried out, while a large amount of valuable geographical knowledge was attained.

2. Kingava Fiord, Cumberland Inlet, in latitude 66° 36′, longitude 67° 13′ west of Greenwich, established by the German government. This expedition, commanded by Dr. W. Giese, sailed from Hamburg, June 27, 1882, and arrived at its destination, Aug. 12: the vessel returning Sept. 8, the regular work of the station having begun the previous day, and all the observations in good running order by Sept. 15. The expedition returned to Germany in August, 1883, having carried out the international programme, and obtained valuable ethnological information in regard to the Eskimos, without mishap or serious illness of any of the party.

3. Nain, Labrador, in latitude 56° 30′, longitude 62° 0′ west of Greenwich, established under direction of Dr. R. Koch by the German government. The doctor left Hamburg, July 7, 1882, arriving in Labrador, Aug. 10. Five auxiliary stations were established by the co-operation of the Moravian missionaries, and

l programme carried out at the Nain atory. This station is too far south to icated on our chart.

odthaab, Greenland, in latitude 64° d longitude 51° 42′ west of Greenwich, shed by the Danish government under on of Adjunct Paulsen of the Meteor- l institute. The party, consisting of rsons, left Copenhagen, May 17, 1882, g at Godthaab, Aug. 1. It carried out rk with success according to the pro- e.

ort Rae, on the northern arm of Great Lake, in latitude 62° 38′, longitude 115° st of Greenwich, was established by the ration of Great Britain and Canada, the auspices of the London meteoro- office. The party commanded by Dawson left London, May 11, 1882, and at its destination in August. It car- e international work to a successful ion, and returned to civilization safely ember, 1883.

oint Barrow, Alaska. The station at nie, a short distance from the Point, in e 71° 18′, and longitude 156° 40′ west enwich, was established by the United under the auspices of the Army signal- It was commanded by Lieut. P. H. .S.A., and left San Francisco, July 18, rriving at its destination, Sept. 8. Ob- ons began Oct. 17, but the full series t commence until Dec. 1. They were on with unimportant interruptions until 7, 1883, when the party returned safely Francisco, having carried out the mme, and obtained valuable observations natural history and geography of the

an Mayen Island, at Marie Muss Bay, ude 71° 0′, longitude 8° 36′ west of rich. This expedition was sent out from at the expense and under the supervis- Count Wilczek, and was commanded by Wohlgemuth of the Austrian navy. It omsö, June 20, 1882, and was safely on the island of Jan Mayen by July 13. ations were begun Aug. 1, and carried th fidelity and success. They were l by Aug. 3, 1883, and arrived at Vienna 22d, having enjoyed perfect health dur- r absence, and amassed rich collections ographs, and of the fauna and flora,

ape Thordsen, Spitzbergen, in latitude longitude 15° 30′ east of Greenwich, cted by the Swedish expedition, Mossel ng closed by ice. The expenses of this expedition, under the auspices of the Academy of sciences, were defrayed by Mr. O. Smith, a Swedish merchant. It comprised six men, commanded by Mr. Eckholm, who began observations Aug. 23, 1882, and returned Aug. 28 the following year to Tromsö, having carried out the programme without loss or accident.

9. Bossekop, Norway, in latitude 69° 54′, longitude 23° 0′ east of Greenwich. This station, directed by Mr. Steen with four assistants, was established by the Norwegian government under the supervision of the Meteorological office. Observations were carried on during the year beginning Aug. 1, 1882.

10. Sodankylä, Finland, in latitude 67° 24′, and longitude 26° 36′ east of Greenwich. This station was occupied under the auspices of the Finnish scientific society, at the expense of the government, by a party of four observers commanded by Mr. Biese. Observations were carried on from the middle of August, 1882. This station, like the preceding, being situated on the Scandinavian mainland, the position lacked that element of danger inseparable from the navigation of icy seas.

11. Karmakuli station, Moller Bay, Novaia Zemlia. This station, in latitude 72° 30′, longitude 53° 0′ east of Greenwich, was established by Russia under the auspices of the Imperial geographical society, and commanded by Lieut. Andreieff. The international work was carried on, as well as geographical researches. One man died at this station, owing to an amputation of a limb consequent upon an accidental fracture. With the above exception, this party returned safely in September, 1883.

12. Sagastir Island, Lena delta, at the west mouth of the Lena, in latitude 73° 0′, and longitude 124° 42′ east of Greenwich, was the second Russian station. The party under Lieut. Jürgens left St. Petersburg in December, 1881, but did not arrive at its post until the midsummer following. The international programme work was begun in September, 1882; and at the end of the year, all having gone well, the party volunteered for a second year's observations, which should now be about completed. News from the party may be expected in a few months.

13. Dickson Haven, on the north coast of Siberia, near the Yenisei mouth, was to have been occupied by the Dutch expedition, commanded by Professor Snellen of the Meteorological institute, which sailed on the Varna in the summer of 1882. The expedition was beset near Waigat Strait, and was unable to

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[illegible] — we shall have [illegible] [illegible].

If, however, this [illegible] the subject in a [illegible] to all the light [illegible]. We begin by warning [illegible] against a kind of inquiry which can lead [illegible] conclusion. We refer to [illegible] those made in the following extract from the New-York *Nation* of Aug. 28, 1884: —

Thought-transference, [illegible]

"The Society for psychical research [illegible] grateful for any good evidence bearing [illegible] as thought-reading, clairvoyance, [illegible], and dreams, noted at the time of [illegible] and afterwards confirmed; unexplained [illegible] in places supposed to be haunted; apparitions at the moment of death or otherwise; and of such other abnormal events as may seem to fall under [illegible] the same categories."

It would be difficult for the society to put forth any thing better fitted than this advertisement to lower the estimation in which their work is held by common-sense people. Let us make a little calculation showing how often coincidences of the kind sought for must really occur in our country. Numerical exactness in our data cannot, of course, be reached; all we can do is to make rough estimates which shall not be unreasonably far from the probable truth. Any physician, we apprehend, will consider it quite within the bounds of probability that one per cent of the population of the country are subject to remarkably vivid dreams, illusions, visions, etc. This will make half a million such people in the United States. Each of these persons may be supposed to have fifty friends or relations, of whom one per annum dies. If they are subject to a dream or vision once a week, there is one chance out of seven that they have one on the same day that the friend dies. Let us suppose that it takes a combination of eight separate and independent points of resemblance, between the vision and the circumstances attending the death of the friend, to constitute a remarkable coincidence, and that each of these has a probability of one-half. We shall have, in one case out of two hundred and fifty-six, a remarkable combination of coincidences. Putting these results together, we may infer, that, as a matter of fact, some case of extraordinary coincidence between the circumstances of death, and the dream or vision by a friend of the dying person, does occur somewhere in the country nearly every day in the year. Thus, what the Psychical society will find, will be what we know must exist as the result of chance coinci-

dence. The search after haunted houses is of a different kind, but the result must be equally inconclusive: all that can be discovered is cases in which the cause of some apparently singular phenomena happened to be undiscoverable. The idea seemingly entertained by the psychists — that the residuum, after they have eliminated all cases in which the natural causes could be found, must be genuine — has no logical foundation. One can hardly lie on his bed awake an hour after midnight without hearing some sound the cause of which it is beyond his power to guess; and we do not see any essential distinction between this case and that of a haunted house.

The general question at issue is, whether there is any such process as what the psychists very happily denominate 'telepathy,' which may be defined as *feeling at a distance* without the intervention of any physical agent. And just here we have the real point at issue between them and those people 'of the earth, earthy,' who think their work is all nonsense. The real questions are two in number, —

First, Can the mind be influenced by things external to itself in any other way than by such things acting physically upon the nervous system? Second, Can the mind, by any act of the will, produce any effect outside of itself, except through the agency of the organs of motion of the body itself acting according to physical laws?

The two questions may, perhaps, be combined into one by inquiring whether it is possible that mind can affect mind otherwise than by some physical connection between the nervous systems with which the two minds are associated. That there is a natural tendency to believe in the possibility of the so-called telepathy is, no doubt, well known to all who have considered the subject. The frequently expressed view that the mesmerizer influences his subject by the mere act of his will, and especially the readiness with which this view is received, may be cited as an example. But it is none the less true that the longer we live, the more evidence we see that there is no such action. It is true that this evidence is negative, and so may always lack something of being conclusive; yet the more closely we look into the case, the less foundation we can see for any positive belief in telepathy. We must remember that the physical connection through which one mind affects another may be of the most delicate kind; may, in fact, nearly evade all investigation. The slightest look, an unappreciable motion of the muscles of the mouth or eyes, made perceptible through the light which is reflected to the eye of the second person, constitute a physical connection. Now, since in the operations of mesmerism the subject is always within easy sight or hearing of the operator, there is always room for the action of a physical cause between the two through the intervention of light or sound. Telepathy between the two could be proved only by finding that the subject was affected by the mesmerizer when the latter was not within sight or hearing or knowledge of the former.

The Society for psychical research has published in its proceedings very detailed accounts of a number of investigations undertaken by its committees and members, some of which are very striking. The report of the committee on haunted houses, however, can hardly be regarded by lookers-on as any thing better than very scientific children's ghost-stories. The extraordinary cases of events or accidents happening to one person being reproduced in the imaginations or visions of others at a distance, are nothing more than recitals of what we know, from the theory of probabilities, must be very frequent occurrences. A feature of these coincidences which ought not to have escaped the notice of the society is, that they have no feature in common by which they can be traced to the action of a general cause, and do not even tend to show that there are particular persons who possess the faculty of being influenced by telepathy. A very striking case is that which most of our readers may have seen, in which a lady awoke under the impression that she had received a blow in the mouth at the very time when her husband, a mile or two away, actually did receive such a blow. Now, if this lady had repeatedly felt her husband's impressions in this way, or if it could be shown that a blow in the mouth or on any other part of the person often makes itself felt by telepathy, the case would be better worth inquiring into; but there is no common feature of this kind in the cases as reported, and they thus fail to supply good evidence that they are any thing more than mere chance coincidences.

The only case that looks at all strong in favor of telepathy is that in which one person is made to draw figures similar to those thoug of by another in his neighborhood. If a the members of our home society can s in making this mechanism work, they wi something of great interest to show th observer. But we apprehend that th ulous will, under almost any circu require stronger evidence tha has any prospect of getti

believe that there is no physical cause in action by which the subject has an inkling of the drawings he is to make, or an indication whether he is going right or wrong. This incredulous tendency will be greatly strengthened if the assistance of spiritualistic performers is called in. S. NEWCOMB.

RADIANT MATTER IN AN EDISON LAMP.

IN the Edison exhibit at the Electrical exhibition was shown a phenomenon that deserves careful investigation at the hands of physicists. Midway between the two wires which carry the current to the carbon filament of an ordinary incandescent lamp, a third wire is inserted, which terminates in a thin strip of platinum extending up midway between the branches of the loop with its faces turned towards them, and ending about half an inch below the crown of the loop. When the lamp was in action at its ordinary state of incandescence, if a circuit was closed through a galvanometer between the insulated terminal of the platinum strip and either terminal of the carbon filament, it showed a current flowing across the vacuum of the lamp, between the platinum and the carbon, in opposite directions, according to which pole of the carbon was connected, but much stronger — forty times stronger — when the platinum was connected to the positive pole of the incandescent carbon; this through a galvanometer of about twenty ohms resistance. Moreover, this current was increased when the current through the lamp was increased, so as to heat it much beyond its normal temperature.

After the lamp has been in use for some time, the stronger, positive-platinum, current becomes weaker, and finally changes direction. By letting the lamp rest, the experiment may be repeated. The same currents were obtained *through the glass* when either terminal of the carbon was joined to a small piece of platinum stuck anywhere on the *outside* of the lamp; the same effects were also obtained when the bulb was drawn out into a long tube and the connection made at its end, and when this ...e was packed in ice to cool it down; but tai... the tube was bent round into a loop, no two ...t was obtained, probably from the cut-one c... of rectilinear radiation from the car-ject wi...

which ...ld seem as if here were a field for the othe... Crookes's experiments on radiation. unworthy

H. M. PAUL.

THE AMERICAN ORNITHOLOGISTS' UNION.

THE second congress of the American ornithologists' union was held in the American museum of natural history in New York, Sept. 30 and two following days. Dr. Philip Lutley Sclater, Mr. Howard Saunders, and the Rev. E. P. Knubley, of the British ornithologists' union, were present, and took part in the proceedings. A large number of new members were elected.

The report of the committee on the revision of the nomenclature and classification of North-American birds was presented by Dr. Elliott Coues. The work of the committee had been divided; Messrs. Ridgway, Brewster, and Henshaw being charged with determining the status of species and sub-species, while Mr. Allen and Dr. Coues were to formulate the canons of nomenclature and classification. Dr. Coues read at length the report of this last sub-committee, the reading occupying about an hour and a half, after which Mr. Ridgway presented the report of the other sub-committee, which emphatically and unanimously indorsed the employment of trinomials for the designation of sub-species.

The report of the committee on bird-migration was presented by Dr. C. Hart Merriam. This committee had been very industrious, and had been greatly helped by the public press; so that, by the distribution of nearly six thousand circulars, the committee finally secured nearly seven hundred observers, in addition to the keepers of lights. The observers are distributed as follows: Mississippi valley district (Prof. W. W. Cooke, superintendent), 170; New-England district (John H. Sage, superintendent), 142; Atlantic district (Dr. A. K. Fisher, superintendent), 121; Middle-eastern district (Dr. J. M. Wheaton, superintendent), 90; Quebec and the maritime provinces (Montague Chamberlain, superintendent), 56; district of Ontario (Thomas McIlwraith, superintendent), 38; Pacific district (L. Belding, superintendent), 30; Rocky Mountain district (Dr. Edgar A. Mearns, superintendent), 14; Manitoba (Prof. W. W. Cooke, superintendent), 10; British Columbia (John Fannin, superintendent), 5; North-west territories (Ernest E. T. Seton, superintendent), 5; Newfoundland (James P. Howley, superintendent), returns not yet received. Migration-stations now exist in every state and territory in the union, excepting Delaware and Nevada.

The committee was fortunate in obtaining the co-operation of the Department of marine and fisheries of Canada, and of the Lighthouse board of the United States. By this means it secured the free distribution of upwards of twelve hundred sets of schedules and circulars to the keepers of lighthouses, lightships, and beacons, in the United States and British North America.

The returns thus far received from observers were exceedingly voluminous and of great value; they were so extensive, indeed, that it was utterly impossible for the committee to elaborate them without considerable pecuniary aid.

In order to show the union the character and extent of the labors of the committee, the chairman had requested the superintendents of all districts east of the Rocky Mountains to prepare reports upon five common, well-known, and widely distributed birds, — the robin, catbird, Baltimore oriole, purple martin, and nighthawk; and these reports were presented for examination.

The chairman called attention to the action of the International ornithologists' congress held in Vienna last April, stating that he had been instructed (in common with the delegates from other countries) to represent the cause of the committee to the national government, begging it "to further to the utmost the organizing of migration-stations," and "to appropriate a sufficient sum for the support of these stations and for the publication of annual reports of the observations made." The council was instructed to memorialize the U. S. congress, and the parliament of Canada, in behalf of the work of the committee on bird-migration.

The report of the committee on the eligibility or ineligibility of the European house-sparrow in America was presented by Dr. J. B. Holder. Dr. Holder said that a circular of inquiry had been printed, and about a thousand copies circulated in Canada and the United States. Particular pains had been taken to secure evidence from those who advocated the cause of the sparrow. A large number of returns had been received, and the evidence for and against the naturalized exotic had been carefully sifted and summarized. The result overwhelmingly demonstrated that the sum of its injurious qualities far exceeds and cancels the sum of its beneficial qualities: in other words, it was the verdict of the committee that the European house-sparrow is not an eligible bird in North America. The union sustained the decision of the committee.

The report of the committee on faunal areas was presented by Mr. J. A. Allen. Mr. Allen said, that, for the purposes of the committee, North America had been divided into several districts, each of which had been placed in charge of a member of the committee, as follows: arctic and British America and the northern tier of states bordering the Great Lakes, from New York to Minnesota inclusive, were being worked by Dr. C. Hart Merriam; Canada south of the St. Lawrence, and New England, by Mr. Arthur P. Chadbourne; the eastern and middle states from New Jersey to Florida, and west to the Mississippi River, by Dr. A. K. Fisher; the Rocky Mountain region, by Dr. Edgar A. Mearns; and the Pacific region, by Mr. L. Belding. It was the plan of the committee to collate and tabulate the required data from all published sources, to avail itself in like manner of the material contained in the returns of the observers of bird-migration, to illustrate the facts thus obtained by colored maps showing the summer and winter range of each species, and to generalize the final results and place the same before the union, accompanied by colored charts, showing, with as much precision as possible, the exact limits of the several faunal areas in North America.

Dr. P. L. Sclater said he was glad to know that North America, which he knew as a nearctic region, was being worked in so thorough a manner by so competent a committee, and that the results obtained could not fail to be of great interest and value.

The matter of the wholesale slaughter of our native birds for millinery and other purposes was brought forcibly before the union by Mr. Brewster, and a committee was appointed for the protection of North-American birds and their eggs against wanton and indiscriminate destruction.

Dr. Leonhard Stejneger exhibited a stuffed specimen of a willow grouse from Newfoundland, which he regarded as a new geographical race, differing from the continental form chiefly in the possession of more or less black upon its primaries. Mr. Brewster said that he had recently examined nearly one hundred and fifty specimens of ptarmigan from Newfoundland, and had observed the peculiarities pointed out, but did not consider them constant. He was inclined to regard the characters mentioned as seasonal, and possibly to some extent individual. Dr. Stejneger replied that this coloration of the wing-feathers could not possibly be seasonal, as they (the primaries) were moulted but once a year. Dr. Merriam stated, that, during a recent visit to Newfoundland, he had examined a very large number of willow grouse in the flesh, and was still engaged in investigating the change of color in this species. His studies led him to disagree with Dr. Stejneger's last statement. Dr. Merriam was convinced that the change in color in individual feathers did take place both independent of and coincident with the moult. Mr. D. G. Elliot agreed with Dr. Merriam in considering the change of color of individual feathers an established fact. An animated discussion followed, and was participated in by many members.

In response to a call from the president, Dr. P. L. Sclater said he hoped the members of the union would excuse him if he offended the feelings of any one by the remarks he was about to make. It had grieved him much to find in this country three large and valuable collections of birds which were not under the care of paid, working ornithologists. One of these is in Boston, one in New York, and the third in Philadelphia. Each contains what all ornithologists admit to be most valuable typical specimens. A grave responsibility rests upon the possessors of types of species, and the loss or injury of such specimens is a great and irreparable loss to science. The collection of the Boston society of natural history (known as the LaFrenaye collection) has been much damaged by neglect; and the entire collection ought now to be catalogued, and so arranged as to render any particular specimen readily accessible. In the American museum of natural history in New York are the types of the celebrated Maximilian collection, and many other specimens of exceeding great value. A large number of these have never been properly identified, and some of them are missing and have doubtless been destroyed by insect pests. The value of others has been lost through neglect, by the displacement of labels, and by the omission of

proper measures for their preservation. The same remarks would, in a general way, apply to the collections of the Philadelphia academy of natural science. It is sad to find no paid ornithologists in charge of these exceedingly valuable collections, and he begged to suggest that the union could undertake no worthier task than to impress upon the proper authorities the urgent necessity of immediate action in this matter.

The officers of the union were re-elected as follows: president, J. A. Allen, Cambridge; vice-presidents, Dr. Elliott Coues and Robert Ridgway, Washington; secretary and treasurer, Dr. C. Hart Merriam, Locust Grove, New York.

THE MERIDIAN CONFERENCE.

THE International conference for fixing upon a meridian to be employed as a common zero of longitude met at Washington, Oct. 1, in the diplomatic hall of the State department. Forty delegates were present from twenty-five nations. Of these, sixteen were represented, wholly or in part, by members of the diplomatic or consular service; and, as the State department took charge of the affair, the proceedings have been surrounded with much of the secrecy of that office. As a consequence, the questions involved have been very little discussed from the stand-point of scientific or commercial convenience, but the time has been mostly taken up with political diplomacy and sentiment.

The representatives of this country were Rear-Admiral C. R. P. Rodgers, Messrs. L. M. Rutherford and W. F. Allen, Commander W. T. Sampson, and Professor Cleveland Abbe; and, at the first meeting of the conference, Admiral Rodgers was elected president. In his opening address he referred to the wide extent of this country in longitude, but said there was no desire to urge the choice of a prime meridian within its borders. The rest of the session was occupied in discussing proposed methods of conducting the conference, etc.

At the next meeting, on Oct. 2, Lieut.-Gen. Strachey of Great Britain, Mr. Janssen (director of the observatory at Meudon, France), and Dr. Cruls (director of the Rio Janeiro observatory) were elected secretaries.

Commander Sampson then introduced a resolution to invite the superintendents of the *American ephemeris* and of the Coast and geodetic surveys (Professor Newcomb and Dr. Hilgard), Professor A. Hall, Dr. Valentiner (director of the Karlsruhe observatory), and Sir William Thomson, to attend the meetings. A long discussion arose as to whether these persons were to take part in the proceedings, the French delegates opposing any such proposition. The resolution was finally passed as it stood; and Commander Sampson then introduced another, that the gentlemen who had just been invited to attend the meetings of the conference be permitted to take part in the discussion of all scientific questions. The French delegates again strongly objected to allowing any private individuals, however eminent, who were not authorized by their respective governments, to influence the decisions of the conference. After considerable discussion, the motion was lost, eight to thirteen, each nation having one vote.

Gen. Strachey then introduced, as a substitute, that the president be authorized, with the concurrence of the delegates, to request an expression of the opinions of the gentlemen invited to attend the conference on any subject on which their opinion might be likely to be valuable; and this was adopted without debate.

Commander Sampson then introduced a resolution that the meetings of the conference be open to interested visitors. This, after objection on the part of the French delegates, was lost by a vote of seven to fourteen.

Mr. Rutherford, in order to give direction and precision to the work, then submitted a resolution that the conference propose to the governments represented the adoption, as a standard meridian, of that of Greenwich, passing through the centre of the transit instrument at the observatory of Greenwich.

The two French delegates made extended remarks opposing such a direct resolution, stating that this conference had no authority definitely to adopt any meridian; that it should not be influenced by the decisions of the geodetic conference last year at Rome, since that was purely a meeting of scientific men on a technical matter, while this conference was more international in its character, and should examine the thing from a political stand-point, Mr. Janssen even going so far as to express the opinion that it should confine its deliberations to the question as to whether a common zero meridian were desirable.

Gen. Strachey said we could not ignore the work of the geodetic conference at Rome; that, composed of some of the most eminent scientific men of all countries, who had fully discussed all these questions, its decisions must carry weight; that while this conference had no authority to enforce its decisions, yet it should make them as complete and definite as possible.

Mr. Rutherford said, that a discussion as to whether it were advisable to adopt a common zero meridian or not was a waste of time; that it was taken for granted by our government in issuing the invitations, and by the others in accepting them, but, out of deference to the wishes of the French delegates, he withdrew the resolution temporarily. Another was then offered by Commander Sampson, stating the desirability of adopting a universal meridian, and it was unanimously agreed to. Mr. Rutherford then renewed his original resolution for the adoption of the Greenwich meridian, and Mr. Janssen reiterated his objections to it.

A discussion followed as to the powers of the conference, and the intentions of this government in calling it. Mr. Rutherford referred to the language of the secretary of state in the invitations, saying that each government was invited "with a view to learning whether its appreciation of the benefits to accrue

to the intimate intercourse of civilized peoples from the consideration and adoption of the suggested common standard of time so far coincides with that of this government as to lead it to accept an invitation to participate in an international conference," etc., and said that they were here to fix upon that meridian; that the delegates must have studied the matter before coming here; and that no one would be likely to come unless he knew, or thought he knew, something about the matter.

Most of the delegates then stated that they had no power to bind or pledge their governments, but only to *recommend* to them the decisions of the conference.

Mr. Fleming, one of the English delegates, called the attention of the conference to the act of congress which called them together; viz., —

"That the president of the United States be authorized and requested to extend . . . an invitation to appoint delegates . . . *for the purpose of fixing upon a meridian*," etc., and said that the word 'recommend' was not used at all.

There being, apparently, considerable doubt as to just what they were there for, the conference adjourned over for four days to get further light on the subject.

At the third meeting, on Oct. 6, the pending resolution of Mr. Rutherford was so modified as to define the meridian of Greenwich as a standard meridian *for longitudes*; and it was then temporarily withdrawn to give an opportunity for the French delegates to introduce a resolution providing for a prime meridian having a character of *absolute neutrality*, cutting no great continent.

Gen. Strachey said that the conference at Rome had concluded that a prime meridian must pass through an observatory of the first order; and only those of Berlin, Paris, Greenwich, and Washington fulfilled this condition.

Commander Sampson summarized the many points necessary and desirable in a prime meridian; and, on the side of convenience and economy, he made the strong point, that seventy per cent of all the shipping afloat now use the Greenwich meridian, and that the cost of the plates now engraved for charts reckoning from Greenwich was seventy-five per cent of all the world's charts. To adopt any other meridian would necessitate changing all these, which cost about ten million dollars.

Mr. Rutherford said that the Paris observatory must soon be moved out of the city, and only sentiment kept it where it was; while Greenwich observatory was in an isolated park, secure from injurious encroachment.

Mr. Janssen defended the proposed neutral meridian, saying, that, if that principle were rejected, it would be useless for him to continue the discussion. He went into a long defence of the plan, historical, sentimental, and patriotic; giving the history of the Isle of Ferro as a zero of longitudes, the great work of the French in early days in astronomy, navigation, and chart-making, and how many valuable charts they now possessed, etc. The only point worth combating was the statement that the needs of the common prime meridian were limited to geography or hydrography alone, and were entirely distinct from the meridians for astronomy, geodesy, and topography, which were local national affairs, and might just as well have separate and independent meridians; in this ignoring the principal objects of the conference.

Professor Adams of Cambridge, England, said that Mr. Janssen's argument seemed to be a defence of the Paris meridian rather than of a neutral meridian, and to be based simply on motives of sentiment and patriotism; that the question of convenience and least change from present status was not touched upon. Besides, why talk of a *neutral* meridian? They were not belligerents, but were all neutral, as scientific men, or men looking for the greatest good to the whole world, should be. If an entirely new meridian be chosen, an observatory must be set up on it, and connected carefully by telegraph with others, and all existing longitudes changed.

Mr. Janssen tried to insist upon the distinction between astronomical and geographical longitudes, and that such a high degree of accuracy was not needed in the latter.

Professor Adams showed that they must, in any case, depend upon astronomical observations; that even geodetic observations of high accuracy cannot determine great differences of longitude exactly, on account of the irregular figure of the earth.

In accordance with a previous resolution, Professor Newcomb, the superintendent of the *American ephemeris*, was invited to give his views on the question. He said it would be impossible to select a meridian absolutely neutral in Mr. Janssen's sense, as it must be on land, with an observatory upon it connected by telegraph with others. He referred to the impossibility of connecting every newly determined longitude directly with the principal meridian, but said that each country or each region must have its secondary meridian and observatory to connect to, and then the whole system would receive systematic correction as the accuracy of determining the longitude of this secondary observatory was increased. He agreed with Professor Adams that the proposals of the French delegates were based purely on sentiment, and that he should answer them just as the former had done.

Gen. Strachey said that longitude was longitude, and as a geographer he must repudiate the idea of first-class longitudes for astronomical purposes and second or third rate geographical longitudes.

At the session of the conference on last Monday the question of a prime meridian was finally settled. Mr. Fleming, the British delegate from Canada, opposed the pending resolution of Mr. Janssen for an absolutely neutral meridian, because it would only add another to those already used, and advocated that of Greenwich on account of the overwhelming preponderance in its present use over any other; while Dr. Cruls of Brazil favored the neutral meridian. The resolution was put to vote, and lost by a large majority.

The original resolution to adopt Greenwich was then introduced. Mr. Allen presented a resolution of

the Railway convention, held in Philadelphia, Oct. 9, and reciting the importance to railroads of retaining this meridian. The resolution to adopt Greenwich was then passed with only one dissenting vote, that of San Domingo, France and Brazil not voting.

Mr. Rutherford then introduced a resolution to count longitudes in two directions from Greenwich up to 180°, east longitude being plus, and west minus. This was favored by the delegates from Great Britain and Russia, and opposed by Commander Sampson, the latter advocating the plan of counting only in one direction, from 0° to 360°, as simpler. This plan was also favored by the delegate from Sweden, Count Lewenhaupt, who moved to adopt the fourth resolution of the Roman conference, counting longitude continuously through the whole 360°. Pending further discussion, the conference adjourned till Tuesday at one o'clock. On Tuesday the discussion was continued, and the resolution offered by Mr. Rutherford passed by a small majority.

SEMITIC NOTES.

AN interesting collection of oriental antiquities has been brought to this country by Mr. Bernhard Maimon. The collection consists of bronzes, lamps, manuscripts, seals, and an Assyrian barrel-cylinder with inscription. Mr. Maimon offered it for sale at one thousand dollars, but, finding no purchaser for the whole, he leaves the seals and cylinder in the Metropolitan museum in New York, and has sold the other objects to Professor Marquand of Princeton, N.J.

Information dated London, Sept. 28, has been received, that Dr. W. H. Ward, the leader of the Wolfe expedition to Chaldaea, would set out the following week for Constantinople. Here he hopes to be joined by Dr. Sterrett, who has returned to Constantinople from his extensive tour in Asia Minor. From Constantinople the party will perhaps go by Alexandretta, Aleppo, and Mosul, reaching Bagdad toward the close of November. The months of December, January, and February are those most favorable for a visit to Chaldaea; and the Wolfe party expects during this time to accomplish its task. During his stay in London, preparatory to his trip to Chaldaea, Dr. Ward spent his time in the British museum, studying the Assyrian antiquities, and specially acquainting himself with those which are forged. Cylinders are so valuable, that a flourishing business is done in forgeries by some of the enterprising orientals; but the practical eye can always detect traces of the forgery. Usually a mould is made from a genuine cylinder, and the forgery is cast in this mould. The joining of the two halves of the cast cannot be successfully concealed.

Mr. J. R. Jewett, who graduated at Harvard last year, is now in Beyrout, Syria, engaged in the study of modern Arabic. His favorite studies during his last two college-years were the Semitic languages.

D. G. LYON.

TURNER'S SAMOA.

Samoa a hundred years ago, and long before, together with notes on the cults and customs of twenty-three other islands in the Pacific. By GEORGE TURNER, LL.D., of the London missionary society; with a preface by E. B. TYLOR, F.R.S. London, *Macmillan*, 1884. 16+395 p. 12°.

THIS work was prepared under very exceptionable circumstances favorable to its value and accuracy. The author published, in 1861, a volume entitled 'Nineteen years in Polynesia,' which was chiefly directed to narrate the introduction of Christianity into, and the missionary work in, the group of volcanic islands in Central Polynesia, long known as Navigator's Islands, but correctly called Samoa. In the present volume he abandons the missionary style, as well as its subject, and gives the result of his miscellaneous researches for upwards of forty years. He has clearly apprehended the desiderata in the presentation of the results of ethnological research: i.e., he has confined himself almost exclusively to the detail of facts, classified so as to assist students, but has left to specialists all promulgation or advocacy of theories. The result is that very few works are of greater value in assisting the study of comparative ethnology, or in the solution of problems in physiology, mythology, history, and philology.

The volume, being a repertory of an immense number of details in all branches of anthropology, affords little opportunity for such quotation as would give any true idea of its value. It must rather be regarded as a brief encyclopedia of the various titles to which the sociologist, the linguist, the student of folk-lore, the physiologist, and indeed all persons interested in the several divisions of anthropology, can turn with profit. The mythic traditions and the folk-lore constitute, to the general reader, perhaps the most attractive part of the work. In this connection it may be proper to offer a slight criticism.

In the cosmical genealogy, an early character is called 'Valevalenoa,' or, as translated, 'Space.' This deity had a long-legged seat; and, after a time, 'Cloudy Heavens' brought forth a head, which fell from the heavens. 'Space' set it up on his high stool, and said to it, 'Be a son, be a second with me on the earth.' Space started back, for all of a sudden the body of a man-child was added to the head. The child was sensible, and inquired who his father was. Space replied, "Your father is yonder in the east, yonder in the west, yonder towards the sea, yonder in the land,

yonder above, and yonder below." Then the boy said, "I have found my name: call me 'All the sides of heaven.'" The point for criticism is, that, while the name the boy bestowed upon himself is strictly in accordance with the philosophic status which the Samoan (as well described by the author) had reached, the name or title 'Space' is wholly inappropriate to that status.

What may be the proper translation of the native word 'Valevalenoa,' or whether it can be translated, it is not possible for us to determine; but it does seem clear that the metaphysical conception of 'space' could not have been made by the Samoans.

The genealogical table of the divinity gives 'Tangaloa, the explorer of lands,' as his father, and the 'Queen of earth' as his mother; and 'Tangaloa, the explorer of lands,' was the progeny of 'Tangaloa, the dweller of lands,' as his father, and 'Cloudy Heavens' as his mother; also the parents of 'Tangaloa, the dweller of lands,' were 'Cloudless Heavens' for father, and the 'Eighth Heavens' for mother. After that amount of definiteness, it would not be probable that in an attempt to commence from the first of all, Leai (nothing), and arriving at what might be called the practical account of the earth itself, and its deities, one would be constantly encountered with the conception of 'Space' as the progeny of the foregoing. It is true, that, from a metaphysical point of view, space might as well proceed out of nothing, as nothing out of space; but with the intermediaries mentioned, it would not be in accordance with the general lines of savage cosmogony to have started with nothing, and through a respectably elaborate family tree to have arrived at practically the point of departure.

An instance of light is thrown upon a problem which has for some time occupied physiologists. We refer to the subject of prehistoric trephining as explained by an account of the manner in which headache was cured, confirming the theory of Dr. Fletcher in his address before the anthropological society of Washington in 1881, that the prehistoric trephining was to relieve disease of the brain. The operation was to let out the pain at the crown of the head by the following surgery. The scalp was slipped up and folded over, and the cranial bone scraped with a fine-edged shell until the dura mater was reached. Very little blood was allowed to escape. In some cases the scraped aperture was covered over with a thin piece of cocoanut-shell; in other instances the incised scalp was simply replaced. This is perhaps the first instance in which savage trephiners have been caught in the act with operations on the scale of a custom. The cure was death to some, but most of the cases recovered. To such an extent was this remedy for headache carried on, that sharp-pointed clubs were specially made for the purpose of striking that known weak part of the crown of the head, causing instant death.

The precise operation of trephining has not been found to be practised among the tribes of North America; but they very generally scarified and wounded parts of the body where pain was seated, or supposed so to be. Their philosophy of pain was, that it was an evil spirit which they must let out. The early writers, who believed in the benefits of phlebotomy more than is now the fashion, gave much credit to the Indians for this practice. It was one of the proofs of their advance in medical and surgical science. It is suggested that the custom of cutting the breast, arms, and some other parts of the body, at the mourning ceremonies, may have originated in the idea of letting grief, the pain of sorrow, out of the mourner.

The principles of the taboo are made very clear and expressive by the tale of the devices by which property was protected. For instance, to protect the bread-fruits, the owner would plait some cocoanut leaflets in the form of a sea-pike, and suspend it from one or more of the trees which he wished to protect. The thief would be frightened from touching the tree; expecting, the next time he went to the sea, a sea-pike would dart up, and mortally wound him. Another of the instances is the cross-stick taboo, a piece of any sort of stick suspended horizontally from the tree, expressing the imprecation of the owner that any thief touching it might have a disease running right across his body and remaining fixed there until he died. This is recommended as a contribution to the literature on the mysticisms of the cross.

The interesting subject of tattoo marks is also dwelt on with more than usual information. Reference is made to the mistake of Behrens in describing the natives of Samoa in his narrative of 1772, when he stated that "they were clothed from the waist downward with fringes and a kind of silken stuff, artificially wrought." A nearer inspection would have shown him that the fringes were a bunch of red leaves glistening with cocoanut-oil; and the kind of silken stuff, the elaborate tattooing. An interesting point is the worship of the octopus, or cuttle-fish, which may be compared with its

frequent appearance in the tattoo marks and religious customs of the Haida and other Indians of the north-west coast of America.

The author, not confining himself to the group of the Samoan islands in his forty years' experience, made notes upon the cults and customs of twenty-three other islands in the Pacific Ocean, which are published in this volume. Among these, with reference to the island Nukufetau, is found a singular reversal of the premium on families given by Roman law, and the merit generally attributed, in communities untaught by Malthus, to the production of numerous offspring. Infanticide there was the law of the land. Only one child was allowed to a family. Under special circumstances, and by paying a fine, a second might be allowed to live.

On the whole, and in general terms, without further attempt at quotation, the volume can be strongly recommended as being illustrative of the stage of ethnic life comprehended in it, and as almost above criticism.

THE HOME RAMBLES OF AN AMERICAN NATURALIST.

A naturalist's rambles about home. By C. C. ABBOTT. New York, *Appleton*, 1884. 485 p. 12°.

It is not often that one can sit down and become so absorbed in a book that he ceases to be critical. It is in this condition that we lay down Dr. Abbott's charming volume. We do not know whether some of his statements need qualifying or not. We do know, however, that the author is an accurate observer, and, furthermore, that he lives amid the scenes and experiences so graphically described. The three brooks, woodshed, fences, etc., do exist, and belong to Dr. Abbott's homestead. The author has been known to the reading public for many years by his articles in the *Popular science monthly*, *American naturalist*, and *Science*. He is more widely known by his being the first to discover palaeolithic implements in North America, and as the author of the work entitled 'Primitive industry.'

The present book is, as the title indicates, the rambles of a naturalist about home. The [illegible] and scenes are so well depicted with pen [illegible] illustrations are not needed, and the [illegible] had the good sense not to attempt [illegible]. Nothing but a sensitive-plate, timed to [illegible] of a second, would be of any use in [illegible]. Speaking of a white weasel, he [illegible] fell into the hands of a taxidermist, [illegible] to science.' Such a fate often awaits the exploits he describes when they fall into the hands of an artist.

Many new and interesting facts are given concerning the habits of wild animals, and at the same time he corrects a host of erroneous observations that have gone unchallenged for many years, because no one competent for the work has given the time and patience necessary to the study. His glimpses of wildcats, and the fight between a turtle and mink, are curious experiences, and his observations of the skunk are extremely interesting. He alludes to the peculiar power of the skunk as causing an 'atmospheric disturbance'! The rapidity with which a skunk burrows in the ground is quite a new fact. He shows how untrustworthy most weather-lore is, as based on the habits of animals, though he admits that chipmunks appear to foresee the occurrence of a cold rain twenty-four hours in advance. He also shows — it seems to us conclusively — that the opossum does not 'play possum,' and that its supposed power of feigning death is the result of paralysis from fear.

He believes that the gambols and antics and various curious behaviors of animals are evidences of play and fun, as in children, and that in no other way can such behavior be explained. Even among fishes has he observed movements that must be referable to the same desire. We can commend the book most heartily to all lovers of nature. It is a book to be put into the hands of every boy, and we should like to see it adopted in our schools as an occasional reading-book.

THE LIFE OF ELLEN WATSON.

A record of Ellen Watson. Arranged and edited by ANNA BUCKLAND. London, *Macmillan*, 1884. 6+279 p. 8°.

ELLEN WATSON'S claim to remembrance does not rest upon what she did, but upon the promise she gave of what she might have done had her life been longer. At the age of twenty she entered University college as the first woman-student in mathematics and physics. Professor Clifford soon formed a very high opinion of her mathematical ability, and believed that she possessed a rare faculty for original work. In the examination which was held at the end of the year, he was careful not to allow his judgment to be influenced by the fact of her youth and sex; and the most strict examination of her papers gave her the highest number of marks gained by any of the class, and placed her in the position of first

mathematical student for that year in University college. She was awarded the principal prize in applied mathematics and mechanics, and the Mayer de Rothschild exhibition; and Professor Clifford said, at the meeting for the distribution of prizes, that a few more students like Miss Watson would certainly raise University college to a status surpassing that of institutions twenty times as rich, and which had been two hundred years longer in existence. Praise like this from Professor Clifford would have been remarkable if it had followed years of preparation under such skilful training as English tutors know how to give. Ellen Watson had not only carried on her studies by herself, but she had been from the age of sixteen the governess, the playfellow, the nurse, of a large family of younger brothers and sisters. In order to get a little uninterrupted time for the study of quaternions and the calculus of variations, she had been obliged to form the plan of going to bed with the children, and getting up at four o'clock in the morning to begin her day's work. Such success, under such circumstances, gives reason to believe, that, if she had lived, she would have been one of the most remarkable women of her time. Her disease was consumption; and it does not appear that her death, at the age of twenty-four, was hastened by overwork. No less remarkable than her intellectual ability were the sweetness and elevation of her character. Her later correspondence shows a lofty aspiration, a passion for some high undertaking for the good of the world which her early death prevented her from entering upon. Great minds of either sex are not so common that one can feel less than profound regret that one more has been extinguished without great work accomplished.

NOTES AND NEWS.

The parental relation of the large cyclonic areas of low pressure that frequently pass over our country, and which might well be called simply *cyclones*, to the tornadoes that are formed in them, has lately been discussed by W. M. Davis in the *American meteorological journal* for August; and by H. A. Hazen in the same, and in the *American journal of science* for September. The former gives a graphic illustration of about one hundred tornadoes that occurred last spring, according to Lieut. Finley's maps; the latter gives a tabular statement of a number of tornadoes of earlier years. The results agree in showing the close limitation of tornadoes to a district south-south-east of cyclone centres, as has already been pointed out in these notes; but the authors differ as to the theoretical meaning of this limitation.

— Professor Simon Newcomb, LL.D., superintendent of the U. S. nautical almanac, has been appointed professor of mathematics and astronomy in the Johns Hopkins university.

— The comet discovered by Wolf at Heidelberg, on Sept. 17, proves to belong to the interesting family of periodical comets, according to the calculations made at the Harvard college observatory by Mr. S. C. Chandler, jun., and Mr. Wendell. An attempt was made to compute an orbit from observations, Sept. 20, Oct. 1, and Oct. 11; but it was found that they could not be represented within several minutes of arc on the assumption of parabolic motion. The parabola obtained was, perihelion passage, 1884, Nov. 14, 23,309, Greenwich mean time; perihelion from node, 170° 40′ 36″.0, 1884.0; node, 197° 16′ 24″.3, 1884.0; inclination, 34° 0′ 46″.8, 1884.0; log. perihelion distance, 0.273507; which gave the deviation of the middle place $(C - O)$, $\Delta\lambda \cos\beta = +7' 35''.8$, $\Delta\beta = +4' 40''.5$. These residuals could not be sensibly reduced by varying the ratio of the extreme curtate distances. Accordingly an orbit was computed without any assumption as to the form, with the following result: perihelion passage, 1884, Nov. 17, 71,070, Greenwich mean time; perihelion from node, 172° 36′ 40″.5; node, 206° 27′ 36″.5; inclination, 25° 10′ 54″.3; log. perihelion distance, 0.196049; mean distance, 3.53638; eccentricity, 0.555885. The corresponding period is 2,429 days, or about 6.65 years.

This comet accordingly appears to belong to the group of the Faye-Möller comet, 1857, iv., and 1874, iv., all of which have general features of resemblance. There is no evidence of any known previous appearance of this comet. If, indeed, the period above given is not considerably in error, it would be visible from the earth only at every third return to perihelion, or once in twenty years.

— Dr. Charles Rau, curator of antiquities in the U. S. national museum, Washington, D.C., is about to publish, under the auspices of the Smithsonian institution, a most valuable and interesting work entitled 'Prehistoric fishing in Europe and North America.' This work will form No. 509 of 'Smithsonian contributions to knowledge,' and consists of about 350 pages quarto. The book is illustrated with four hundred and five cuts from drawings by Mr. Trill, being either copies of already published designs, or correct representations of objects specially drawn for this work, the majority of the latter being specimens belonging to the U. S. national museum. As regards America, objects termed 'prehistoric' include such as are found in mounds and other ancient burial-places, on and below the ground, or in caves, shell-heaps, etc.; in fact, to use Dr. Rau's words, "all articles of aboriginal workmanship, that cannot with certainty be ascribed to any of the tribes which are still in existence, or have become extinct within historical times, or, to speak more distinctly, within the recollection of the white successors of the Indians."

This book is divided into two parts: part i. Europe; part ii. North America. Part i. is divided into three sections: 1°. Paleolithic age, 2°. Neolithic age, 3°. Bronze age. In part i., Europe, a short characteri-

...ericana,' just issued as a bulletin of the ... al survey. They reach the surprising ...24; including, however, under distinct ... re-issues. The annotations are brief but ... and the whole is prefixed by a very interest- ... of the progress of geological cartography, ... of permanent value. An excellent index ... a most serviceable publication.

— ... S. Hall, Ph.D., a graduate of the Univer- ... Michigan, is appointed professor of chemistry ... at St. John's college, Annapolis, Md.

— ... is an error in the reports of the commit- ... of the American association, in our last issue, ... needs correcting. The statements concerning ... committee on an international convention refer, ... that committee, but to the committee on the ... change of courtesies between the American and ... associations for the advancement of science.

— Mr. J. Dickie of Leeds is exhibiting his recently ... invention of an aqua-aërial or wave-ship, ... is supposed to be capable of making the chan- ... passage in twenty minutes, or of running to New ... and back in six days. The aqua-aërial ship ... a different section at different parts of its ...; but it may be described as a broad, flat vessel ... water-tight chambers all round it, and a series ... three inclined planes forming the bottom. The ... ducts are of the usual shape on deck, but spread ... so as to occupy one-half the breadth of the vessel ... the point where they reach the bottom. They are ... situated just at the commencement of the inclined ... planes, and as two are placed side by side there are ... altogether. The object of these ducts is to ren- ... each plane independent of the others; and thus ... are supposed to assist in lifting the vessel out of ... water, as it were, and to facilitate its passage ... the surface. The bows curve downwards from ... at the deck level, and merge into the front of the ... plane of the bottom; while the water-tight com- partments at the sides of the vessel are formed into a sort of platform at the stern, by means of which ...dy-making is to be avoided. The air-ducts have another office to perform; for, by means of self-acting valves, any tendency to roll is said to be immediately counteracted by the air-ducts on the rising side of the vessel closing automatically, thus creating a vacuum on that side, while the greater pressure ex- erted on the water on the other side will tend to re- store it to the normal level. The inventor maintains that the power required to keep up the speed will decrease with the increase of the vessel's rate of pro- gression, 'the only thing necessary being a high speed of engines.' Unfortunately for sea-sick people, we have as yet had no practical proof of the merits of the 'aqua-aërial vessel.'

— A cable despatch was received Oct. 15, at Har- vard college observatory, from Kiel, Germany, an- nouncing the discovery of another asteroid by Palisa. Its position was as follows: Oct. 14, 40.5; right ascension, 2h 18m 26.5s; declination, north 15° 47'; daily motion, west 56", south 6'. It is of the 13th magnitude.

SCIENCE.

PLEMENT TO No. 89, FRIDAY, OCTOBER 17, 1884.

E DISCUSSION ON STORAGE-BATTERIES BEFORE THE ELECTRICAL CONFERENCE IN PHILADELPHIA.

sudden outburst of interest in secondary at the time the Faure battery was first in- in England led to some unfortunate results hape of bankrupt electric companies. The e was that sufficient electricity to do most ousehold work, and give all needed light, left at one's door each morning. The idea of electricity' was a taking one with the public, y as it was introduced with the best of in- nts; but the secondary battery has not proved h a boon as was expected. In view of this blic interest, the discussion on the subject of the leading electricians of England and at the electrical conference was of especial ice. This discussion shows, as well as any n, the present state of opinion among those pable of judging of the secondary battery. ussion was opened by Mr. W. H. Preece.

sor W. H. PREECE, London, England. — I en called upon somewhat unexpectedly to discussion on this question of storage-bat- nd I regret very much that I have no notes to refer to, and that I shall have to trust a al to my memory. As I am not possessed r memory, I don't think I should develop us error, although Mr. Edison himself has that this question of storage-batteries has d the most remarkable power of man's latent for lying. [Laughter.]

much agree with Mr. Edison's definition, hink there has been more lying and more g and more rascality done over this ques- storage-batteries than over any other depart- electrical science. Now, storage-batteries en very improperly called storage-batteries, ery much prefer to call them secondary bat- It is quite true that this subject of storage- is one upon which there is a good deal of eption, which has arisen from the introduc- he word 'storage.' Now, these secondary have been before the world for over twenty nd all the physicists who go to Paris almost ly meet with Planté himself, the father of rument. For the past twenty years, nearly, en one of my great pleasures, when I visited pay a visit to Mr. Planté, who has shown he always shows everybody who sees him, gress that he has made. Mr. Camille Faure, conceived the notion of coating the plates of lead with the oxide of lead. These secondary batteries had not attracted much attention, although Planté's papers deserve the most careful consideration from all electricians; but Mr. Faure found that by coating the positive plate of the secondary cell with a layer of minium, — red oxide of lead, — he considerably hastened the production of the plate. Planté simply depended upon the electrolytic action of the current in peroxidizing his plate. This is an operation that sometimes involves months. Faure's battery fell into the hands of a man who put forward one of the most diabolical schemes that Paris has ever produced. A man by the name of Phillippart placarded all Paris with the most outrageous notices of what this great battery was going to do. Batteries were to be distributed, like milk and ice, at our doors; so that motor power could be obtained and used in our houses, and light could be obtained from them. The result was, that a considerable sensation was created, and an attempt was made to bring out an official swindle; but it did not succeed. Another gentleman was associated with him by the name of Mari. They became associated in London with a gentleman who holds a very high position, and occupies in the financial world a very important place indeed, as the head of the great firm of Mathie, Johnson, & Co., who are large metallurgists. Mr. Sellon joined himself with a Mr. Volckmar. They brought out a compound battery; and a company was formed in London to develop this scheme, and a great deal of money was collected, but all of it has been lost. Mr. Volckmar himself succeeded in playing his part of a plunderer sufficiently to ride about London in a manner indicating a person of great wealth. The fate of this man was sad indeed, for his body was found in the Seine with a bullet through the forehead. Now, two or three other men had been working at this idea, — Mr. Tribe and Professor Bridgeton. They approached the matter in a truly scientific spirit; and the result has been, that Mr. Tribe has brought out a form of secondary cell, although it is not yet in the market, that is a great improvement upon any thing that has ever been brought out before. But all these persons have been working silently upon this subject, and have gone back to Planté's original work, and they have followed Planté's original methods. The batteries that I am going to speak about are hollow,

and the modification of Planté's simple lead cells; the simple cell being two plates placed in a dilute sulphuric acid, one plate oxidized, and the other plate pure. Now, as regards the uses, I have made a great many experiments with these secondary batteries; and first I will speak of the experiments made of their use in telegraphy. Some time ago the idea was mooted that a considerable economy might be effected in the working telegraph if dynamos were used for that purpose. The dynamo-machines are used by the Western union company, and they employ them for their circuits; but they are not used in England, and we have failed to use them for a very obvious reason, which is simply this, that in England we do not work with 'closed circuits.' We work our instruments with rapid reversals; our automatic system, which is so very extensive, sometimes giving us the result of the transmission of three hundred words per minute, with very rapid reversals of very minute currents. It is absolutely essential that these currents should be uniform in their character. Now, the currents produced by the dynamo-machines are not uniform. If a telephone be inserted in a secondary circuit, you will invariably find that you can hear sounds which are indicative of variations of the current, and these variations are fatal to a fast speed of working. But when you use a dynamo, and utilize the current of the dynamo in preparing a secondary battery, you then get a means by which you can produce currents of absolute uniformity. The secondary-battery current flows out absolutely uniform. And, again, it has the great advantage of giving you a battery with a very low resistance. The electromotive force of an ordinary cell is as low as two volts. You may take it as a rule to be two volts. Its internal resistance may be made whatever you like. Now, I had three series of cells made, one set being Dr. Tribe's, and another Planté's: and from each of these sets — there were eight cells to each set — from each of these sets forty circuits were worked; that is, each battery had forty distinct and separate circuits, so that practically we had a hundred and twenty circuits running from these three secondary batteries. Although all worked for about three months, I think the exact time was ninety-six days, all these circuits worked uniformly and perfectly, gave no trouble that would necessitate even the glancing at them during this whole period of three months, and without any attention; when suddenly one failed, and immediately afterward another failed, and then the third failed. They were charged up again, and then they went on for another three months. And they have behaved as well as one could possibly wish; so much so, that one of the first duties that I wish to discharge, on my return to England, will be to arrange for a large supply of these secondary cells, and a further use on a large scale at our battery for the post-office. We have in use, at the general post-office in London, six hundred and fifty circuits centralizing there; and we are now utilizing about twenty-two thousand cells. I think it more than likely we shall be able to work the whole with probably not more than five thousand cells.

Now, as regards electric lighting. I have already used secondary batteries for electric lighting: I have used them in the post-office, and I have used them for my own house. My house is in a portion of the country through which no lines pass for the purpose of electric lighting, and they cannot be found within a reasonable distance: so, if I wanted to light my house by electricity, I must be dependent on my own supply of electricity. I light my house by gas: but I burn my gas in my garden, and I extract from it that which I want, namely, light; and I discharge into the air of my garden that which I do not want, namely, poison. My gas is employed in working a small gas-engine of two-horse power. It is the gas-engine which works a small Gramme dynamo, which, when worked at its full power, gives me forty-two volts and fifty-two ampères. These fifty-two ampères are directed into seventeen cells. The cells are Planté's original cells. The plates themselves are two feet square, and in each cell there are twelve of these little lead plates. The lead plates are made up of four thin sheets of lead, each sheet being about one thirty-second of an inch thick; and they are perforated in squares regularly all over, and these four thin plates are tied together — they are almost woven together — they are tied together with thick worsted. They are arranged in pairs; six on one side forming one pole, and six on the other side forming the other pole. They are placed inside of an ordinary pitch-pine box, and the insulation of the cell is maintained by a thin India-rubber bag which envelops it. It is a loose India-rubber bag of about the same shape, and, when the plates are put in, it forces the India-rubber out, and the bag takes the exact form of the cell, and it makes the cell thoroughly water tight and thoroughly electricity tight. I have seventeen of these cells, all arranged in a series; and my engine, which generates these currents, and charges this battery, is in my garden. My gardener has the gas-engine under his charge. He is an ordinarily intelligent gardener. When he comes on duty in the morning, he lights the gas in the gas-engine, and starts the dynamo which charges my battery; and when he goes away to his dinner, after the engine has been working for three or four hours, the battery is prepared. I go home in the evening: I have got a store of electricity. I have every room in my house fitted up. I have at my bedside a most charming little light, with no smoking, and no trouble with a wick, and no heat, — a mellow light by merely turning on my tap. I have the softest and most delicious light you can conceive of, thrown upon my paper or thrown upon my book. I have had this going on for four months, and I have never had any bother, except on one occasion, when the gardener put his foot on the wrong place, and the engine came down upon his foot, crushing his toes.

I have a strong impression, that, for all isolated places similar to mine, the storage-battery is an essential thing, and I think that some one is bound to work out this question. Several are now pegging away at it. Sir William Thomson spent much time in investigating this subject, and has given it a great deal of attention, but has not succeeded, simply because you can use a Planté cell untrammelled by any patent. It

is at your disposal, and nobody will interfere with you. If anybody else chooses to follow my example, I think they can do precisely the same thing. But there are, after all, one or two other uses for secondary batteries. Now, I have been very luxurious and very extravagant in carrying out this arrangement. For instance: I have a little daughter who has a very pretty doll-house. Her doll-house consists of six rooms; and each room is well furnished, and well populated with charming little dolls. It is, of course, necessary that each room should be supplied with a charming little electric light: so each room is supplied with this light. Then, I have a cigarette-lighter, consisting of a piece of platinum which can be rendered red-hot by the secondary battery. The difficulty in doing that sort of thing with the usual mode of distribution is that you want the benefit of cutting off a portion of your current. I interrupt a current, flowing, say, six-tenths of an ampère, by putting into the circuit, by a switch, a secondary cell, that diminishes the light, and sets up a counter-electromotive force of two volts for the time being. While that cell is in the circuit, your light is a little dim; but when I take from the poles of that secondary circuit two wires in connection with a piece of platinum wire, then the current passes through the platinum; and this current is due to the two volts from the secondary cell. This piece of platinum wire is heated up with a current quite sufficient for the purpose, with only two volts.

Now, there is another field in which satisfactory experiments have been made with secondary cells, and that is, in lighting up trains of cars by electricity. This has been done on one of our railways between London and Brighton. The railway company has been for some months past lighting up one of its express trains with secondary batteries. The dynamo is worked by the motion of the wheel, and the dynamo charges the battery during the time that the train is working, and the battery is being charged during the whole of that time, and the current is being extracted from the battery; so that you have a light in your carriages which is perfectly steady, and quite independent of the motion of the train. And that leads me to a point which I omitted, and which led me to work so hard at secondary batteries; and that is, that a secondary battery renders the current produced by the inconstant engine and the inconstant dynamo perfectly steady.

It is a difficult thing to say, that, in making an appliance of any kind, we have reached absolute perfection; but I can say this, that, when you have a secondary battery inserted in the electric-light circuit as a shunt (p. 388), it renders your current perfectly uniform, and your light is as near perfection as it can be. Supposing that your lamp requires fifty volts, then you will require twenty-five cells; and I should think myself that it would be quite possible to make cells for this purpose that ought not to cost more than five shillings a cell. You put twenty-five of these in cells: the first current that goes through, simply charges the lead plates; one is coated with oxide, and the other is clear; and you get a counter-electromotive force of fifty volts. The consequence is, no current whatever passes through the secondary cell unless it has once been raised to fifty volts. The whole current goes through your lamp unless there is flickering of the engine. Then, if there is flickering of the engine, the energy that is stored up in the battery passing through the lamps makes the light uniform, and in that way you get the storage effect by the use of the secondary battery.

There are certain defects that have developed themselves in these batteries, that have been gradually cured. The great defect in all secondary batteries is due to buckling, — a fact due to the formation of peroxide upon the plate. You will find your lead plate will buckle up into all kinds of positions, and the two plates will come into contact. This difficulty I have sought to overcome by supporting the two plates by means of a plate made of paraffine-wood; but the most effective arrangement that I have tried is ebonite. This ebonite is furnished, stamped out to the proper size, and is very light and very thin, though quite equal to preventing all buckling.

Secondary cells have not been in use long enough to enable us to determine how long they will last. I have had them in use for four months, with a sign of but little disintegration of the positive plate. I think that the plates will have to be renewed only about once in every two years. Those that I have in use were re-charged at the end of four months.

The charm of the whole thing is such, and its cost is so trifling, that I shall keep it in my house; and I am quite sure that all those who have worked in the same direction in regard to this matter of electric lighting will never give it up. The electric light itself has some sort of a charm about it. Objection is made to the cost of introducing it; but I have protested often and often against the comparison that is drawn between the cost of gas and the cost of electricity. The two things are not to be compared. When we indulge in luxuries, we don't compare the cost of the luxuries with other things. If you want fine 1834 port, you don't compare its price with that of ordinary claret. If you want to indulge in a fine pheasant, you don't compare it with the old cock that crowed before Peter. So, when you have a delightful luxury like electricity, you don't want to compare its cost with that of gas or sperm-candles, or any other mode by which life is shortened and ultimately destroyed. Here we have something that in the out-of-the-way houses tends to lengthen life and to satisfy us, giving us something cool and delicious; and I say, all comparisons with gas are utterly ridiculous. In reference to these enterprising light-companies, they will soon bring electricity to our doors; and we will all take it. When people can get electricity at their doors, and can get it without much cost, as indeed they can, they will certainly have it. So I look upon the days of gas as being numbered; but gas is a most important power, and its uses are just in their infancy. The days of gas as a distributer of power and heat are coming. At the same time, electricity is going to supply light such as we want.

There are many facts connected with the working that I should have liked to give you. I should have liked to give you the efficiency. I have made careful experiments as to the efficiency of the storage up to the present time. The cost is certainly within the reach of every man in this room. Every single man in this room can afford the comfort which this light will give him; and an electric plant will enable him to live four or five years longer in this world than he would without the electric light.

Prof. W. H. HARKNESS. — I was very much pleased and gratified at hearing Mr. Preece's remark as to the use of secondary batteries. After all that has been said on both sides, it is gratifying to find that we have a certain and valuable method of lighting which is effective and economical. I wish also to add my testimony on one or two points which Mr. Preece has mentioned, and that is, to the courtesy uniformly shown by Mr. Planté to any one who visits him at his laboratory. I had the pleasure, with some friends, of visiting his laboratory, witnessing many experiments made with a large number of secondary-battery cells. As we all very well know, his invention has resulted in the adoption, not only of those secondary cells, but also of the cells themselves. The use to which he has put them, however, has led to many absolutely new experiments, so far as I know. It is also a point of interest to know, as probably some of you do know, that Planté himself tried a method, many years ago, of covering the plates with minium. If Professor Barker were here, he would bear witness to the fact that Planté has used both; that he tried the same thing several years ago, and found that it was not so effective as a battery of his own plates by the method adopted, which, though necessarily slow, probably resulted in a better form of cell. So it is gratifying to know, from the experiments of Professor Preece, that we are advancing, so far as new experiments are concerned, and that we are finally going back to the original form devised by Planté.

There may be one reason worth mentioning. We are all well aware of the careful and interesting experiments referred to by Mr. Bright, on the chemistry of the secondary battery. These experiments show us that there is a greater or less formation of the lead sulphate in connection with the cell adopted; and that also shows us why the electromotive force, having run down, after a period of rest, is recovered to a certain extent. A great many points have been cleared up that were certainly quite enigmatical before. Now, some experiments, and I think some of those that have been published by Professor Barker, go to show, that, in the Planté cell as formed by Planté, — by a rather slow and tedious process, but by the method of Planté, — there is at least a small amount of lead sulphate produced. I take it that the giving-out of the cell is due to the formation of sulphate; so that, if these cells are formed by the rules laid down by Planté, they will have a tolerably long life. Now, just one word with regard to the cost. You will remember that a year or so ago Professor Langley showed, I think beyond any question, that the percentage of the radiant energy from an Argand gas-burner that is effective in producing illumination is less than one per cent. It certainly is a very curious result. It is less than one per cent, and there is little doubt about the energy which goes up through the chimney.

Mr. N. S. KEITH. — Planté was evidently far ahead of his time. He produced what is to-day found to be of vast practical importance. In 1860 or 1861, about the time of his published experiments, there was no electric lighting; certainly none as it exists to-day. There were then electric-lighting men who were far ahead of their time; but it is only within the past four years, we may say, that we have had any possible application of the secondary battery. I am led very forcibly to consider this point, because in 1878, during the experiment I was then carrying on in the electrolysis of lead, and in collateral experiments which relate to the chemical action of lead in various solvents and in various electrolyses, I was led to make a secondary battery after having made one of Planté's. I made one by coating the plates with peroxide of lead by electro-deposition — not peroxide of lead formed from the substance of the plate itself, as by Planté; not by coating the lead plate with oxide of lead, or peroxide of lead, as the case may be, from external sources; but by coating it by deposition from a solution of lead in which the plates were immersed. I took two hundred and forty cast pieces of lead plate, each one foot square. I divided them into ten cells, making twenty-four plates of each cell, twelve of which were positive, and twelve negative. By using a suitable solution of lead (a sub-acetate of lead in nitrate of sodium), and by treating that with a current of electricity, I produced decomposition of the solution, deposition of peroxide on the positive plate, and at the same time metallic lead was deposited upon the negative plate in a very finely divided and crystalline state. Some hydrogen is also deposited with the lead, — an equivalent to the oxygen that is deposited in chemical combination with the lead upon the positive plate. These plates, after pressing the metallic lead so as to cause it to cohere and adhere to the plate, were taken from this solution and immersed in sulphuric acid, and gave a very satisfactory secondary battery indeed. At that time (in May, 1878) I ran a dynamo as an electric motor with this battery, and I effected some chemical and electrolytic decompositions in a solution of sulphate of copper, and did some other things which were then the only possible commercial applications of secondary batteries. Since that time, electric lighting by incandescence has come to the front, and we find the great use of secondary batteries which has been so forcibly set forth by Professor Preece. At that time we did not have telegraphy by the dynamo; but we had telegraphy by the use of the primary batteries with which we are all so familiar. I have since that time carried on a considerable number of experiments relating to secondary batteries. The whole subject is an electro-chemical one. There is a chemical decomposition of the solution by the passage of a current of electricity. There is a decomposition of the water of the electrolyte either primarily or secondarily. Oxygen goes

ate, hydrogen to the other. For a new exper- have taken solutions which suffer decompo- ithout delivering free hydrogen and oxygen. aken, for instance, solutions of the sub-salts A current causes decomposition, and a depo- pon one plate of peroxide of lead, and, upon r, of metallic lead. For instance: I have taken, plate, a plate of carbon, and, for the other, a lead. A solution of a low sub-salt of lead l as an electrolyte. By passing a current of y through it, the action is to raise the sub- a proto-salt. This takes energy, which is l by the chemical action. Then the charge icity is returned until the peroxide of lead n entered the solutions, and the lead has also into the solution. The action of the char- rent of electricity is to raise the electrolyte to condition; but the charging action is stopped hat point is reached, because the end would ted in passing it. I am also carrying on periments in the way of storage for elec- r in the use of secondary batteries. I can give particulars, except this: the idea is to the integrity of the plate — of the inside for an indefinite length of time, say, as long be practically worth while. So far, after onths' use, I have been able to oxidize the the desired depth (say, one-sixteenth of an d preserve a backing of metallic lead. Under nge, if my theory and practice be correct, I be obliged to replace, as in the present known batteries, the oxide plate.

CHARLES H. KOYLE. — I should like to say g in reference to the theory of the secondary There are no substances, which, placed in ition in a secondary battery, will give the otive force that the peroxide of lead, and of the Planté cell, laid opposite to each will. It remains as it was in 1859, when xperimented and wrote. I have experiment- other substances; and, although my experi- s not been exactly useless, it has been the g to it.

ecessities of the plate, then, are the only es to be considered. They are three, and very simple ones. First, the plate made must ductor of electricity, and that leaves us the The plate, in the second place, must resist nary action of sulphuric acid: that leaves nd four or five expensive metals, — platinum, on, and gold and carbon. Our list is very duced, as we have practically, for this pur- ly carbon, as the expense of the other metals eat to allow them to be used extensively for cial purposes.

when we get the third and last condition, — is, that the plate must resist both electro- on and the oxidizing action of the current, — resist the electrolytic action of the current ely well. But the oxidizing action of the uces the lead to a peroxide in a very short That leaves us only one thing for a secondary of the future, — carbon.

I think there is no way of upsetting that very short argument. I should be very glad to know if there is. Now, then, the manufacturer of the carbon plates called good, makes plates which shall contain a very large amount of the substance, because the capacity of the storage-battery depends entirely upon the amount of lead and peroxide of lead which you can put upon these plates. They are the substances that you will have to depend upon for your electricity. Of course it is not necessary to say that they will answer the purpose: they are the substances in which the chemical action takes place.

Now, it is possible to take carbon and to manufacture carbon plates by the ordinary method. Take ground charcoal, ground gas-carbon, ground flint, and mix gas-tar with it, or molasses, or any hydrocarbon. This is put into a press and the shape is given to it; and then it is put into a closed furnace and carbonized, so as to drive off the gas, and leave the carbon free. Those plates are pretty good for ordinary primary batteries; but when your lead contains a lot of little holes, very much as the lead now in use does, the plate is very apt to disintegrate. There is such an enormous amount of surface exposed, that the action of the cell is apt to disintegrate the plate, and the metal will scale off. A better way to make the plate is then to be considered. There is a method of making these plates which is very much liked, — a method in use by the U. S. lighting company in the manufacture of carbon for their incandescent lamps; that is, to take celluloid and put it through some chemical operation which deprives it of a part of its gum, thereby leaving a substance very easily carbonized. That substance may be cut into any shape of plates desired. You can make some of these plates thick, and some thin, and you will always have a good plate. It is not very strong, but it is a good plate. Another method, which I myself have used, I have found to work very well, and I shall have more to say about it in the course of a few minutes. At present I can only tell you the general method. I take gas-tar and put it in a closed furnace, and drive out the gas, and so get rid of the ordinary illuminating-gas, the heavier gas, which is condensed as it passes through the tubes. The constitution of the coal-tar depends, first, upon the constitution of the coal; in the second place, upon the temperature at which the gas is driven out. The object is to get out the lighter parts of the coal-tar. Coal-tar is a very composite substance. The physical qualities of coal-tar vary very much, according to the temperature at which the gases were originally driven out, and, again, according to the temperature at which evaporation is carried on. It requires months of experiments, as I have already said, before one can determine what is needed. This coal-tar, when it is thus taken and evaporated, and brought down to a requisite consistency, which is a matter of experience, is taken and put into a box prepared for the purpose, and put in an oven which is closed. The tops of these vessels are covered with sand, and one thing and another, in the ordinary way, to prevent the presence of air; then the heat is

turned on; and gradually this stuff begins to boil. You cannot take up this evaporated mass and tell what will be its quality, until it has been evaporated. Then, formulating these three things, you can tell what temperature you want to use under this tar in a boiling state. Then I have devised a process of quite suddenly increasing the heat. This is done by means of a double oven, one part being heated moderately, and the other to quite a high degree of heat. When the tar no longer boils, it is suddenly carbonized. You then have to make your plate. I take this substance and cut it. It is true, it is carbon, and it is pretty hard, and there is difficulty in cutting it: so I have devised another method to free myself of the trouble of cutting the plates, and that is, to prepare the plates of a proper size. This is a process which I developed last winter. The method of manufacturing which I have described is susceptible of considerable uniformity. The character of these plates is porous, and they are of considerable value in a secondary battery.

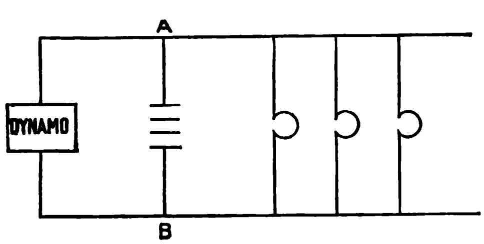
Planté, of course, is the great originator of secondary batteries of modern times. You can take a Planté cell, and you can get forty per cent from it if it is properly charged. A fair battery will return proper work up to ninety per cent. It does not always do it. It has to be carefully charged, and it will return, under careful circumstances, ninety per cent.

Mr. FRANK J. SPRAGUE. — Ninety per cent of the form: is that what the speaker has told us? I should like to know what part of the circuit he uses. Does it include the battery?

Mr. KOYLE. — Including the battery, of course.

Professor FORBES. — I merely wish to draw attention to this very point. The difficulty about manufacturing those plates is to get them of a proper length. We should know exactly what we are dealing with. The action is exactly, of course, as it has been described.

I want to show to you how the equations come out, because they are very interesting in showing the regularity of the secondary battery upon the brightness of the lamps.



Let E_1 be the electromotive force of the dynamo, R_1 the resistance of it; E_2 the electromotive force of the secondary battery, R_2 its resistance: R_3 we will call the resistance of the electric lamps in the circuit. That will represent the resistance of the lights which come into play. This is given by a well-known law. Perhaps that is the simplest way to take it. Let us call the potential at the point A, e_1, and that at the point B, e_2. These are the two points where all the three circuits unite, and e_1 and e_2 are the p at those points. Suppose that e_1 is greater then the current circulating in each of the circuits can be put down immediately in term quantities which are there shown, involving unknown quantities e_1, e_2; the current v circulating in the partial circuit of the always taking the direction of the current as when the current flows from e_1 to e_2. The in this part of the circuit will be $\frac{e_1 - e_2 -}{R_1}$

R_1 being the resistance of this circuit. C_2 is from C_1 by replacing E_1 and R_1 by E_2 and R tively, and similarly for C_3 (R_3 being the resis the lamp-circuit). Finally, we have the equat the sum of all these equals zero; that is to total current which passes through any one equal to zero, which is a well-known law. V therefore, the sum of these currents (C_1 + (equal to zero.

Now, this ($e_1 - e_2$) is in reality the unknow tity. It is a difference of potentials. It is th unknown quantity of this equation. The resu we arrive at on working out this equation $e_1 - e_2 = \frac{E_1R_2 + E_2R_1}{R_1 + R_2}$. This is a very us mula, and probably is well known, and has in applications here. The application especia finding the current which flows through th circuit. The current C_3, which is the curr ing through the lamps, is equal to $\frac{E_1R_2 -}{R_3(R_1}$ that is, the final value of the current which ing through the resistance of the lamp-circui

Now, here is a remarkable thing, — that, much the irregularity of the dynamo-mach be, the current is found to be very steady in th circuit when we use the secondary battery position. The reason of that is, the second teries which we are in the habit of using extremely small resistance; and, whenever secondary batteries, you will understand use an infinitesimally small resistance, compa the resistance of the battery or the resistanc such lamp-circuit.

If, then, we take the resistance of the second

tery to be zero, our equation simply gives us, (

with the other quantities cut out; that is to current is exactly the same as if this dynamo working at all, and as if we had a battery of in mal resistance, with this electromotive forc working through these series of lamp-circuits

As I am here, I may as well make a few upon another point in connection with these ary batteries. Of course, the great diffic have had in the past times was, in the fir that we used thin plates, and they buckled. been the most serious objection that we h And it is very satisfactory to hear from Mr that he found that he practically gets over kling of the Faure cell and Volckmar batter

force generated in these plates, tending to buckling, is something enormous.

I do not think any ordinary separator of material which he speaks of would be sufficient to prevent the buckling of a Volckmar accumulator; for the force generated in these plates, tending to buckle them, is something enormous, and no ordinary separator would be able to resist this. If such resistance were offered to them, I think they would break. The reason why he has succeeded in getting rid of this buckling is because he has reverted to what is evidently the most scientific, and which will ultimately be found to be the most probable, form, that of the old voltaic battery. The objection to the Faure cell was the want of perfect symmetry in the plates, tending to make them buckle, and want of homogeneity in the surface, which tended to introduce local action. And that is the one great defect which has been pointed out some time ago, which I think most people recognize now in all these Faure cells and Volckmar batteries.

I wish Mr. Preece would give us some further information about the length of life of these cells; because although he has them in his charming house, and although they last only four months, does not everybody who will call want to obtain some more definite information? and I think there must be some gentleman here who can give us more information about the life of these batteries. As a matter of fact, the larger form of Planté battery, the improved type of batteries, which I believe were tried generally with nitric acid in order to render them more powerful, have been generally used with lead, but only within the last year or two, and therefore their absolute life is not determined; but I believe it is perfectly conceded that these voltaic batteries as they have been prepared with lead, and as Mr. Preece has them in his own establishment in his own private house, are the longest-lived batteries, — far longer lived than any artificial batteries such as the Faure cell and the Volckmar.

Mr. F. C. Van Dyck. — I do hope the people will not be discouraged in working in the line of other batteries besides the old one. I think there are cases in which the battery is sure to have a long life, and sure to keep itself charged without loss for a great length of time.

There are many uses for such a battery as that; and my own work satisfies me that the zinc alkaline and copper battery will fill a considerable want; for instance, running the magnetic apparatus in observatories, and work of that kind. I have made a small battery of that kind, using a spiral of copper above, and amalgamated zinc below, so as to avoid the falling-down of the deposit of zinc upon the copper, thereby amalgamating the copper, and rendering it far less efficient. Although the electromotive force is only ninety-seven and ninety-eight hundredths of a volt, still we found by actual trial that charging the battery and letting it stand, then letting it run down and taking the readings at the time, and then letting it stand for two or three months — we found there was not enough difference in the readings to show the slightest loss; the battery had retained its charge, so far as we could find out by the means at our command, perfectly for two months; which I think is a good showing. Long ago I found, in using a battery, that I had to be very particular about the electromotive force to be used in charging it. I have not finished my experiments so as to state precisely the electromotive force, but it is somewhere between a Daniell and a Grove. If you charge a cell of that kind with a Grove cell, you will find that the copper strip will be altogether dissolved by alkaline solution, forming the cuprate of soda or potash, according to the alkaline used. Then that breaks up in the form of oxide of copper. But, if you are particular about not running beyond the Daniell, there is no such difficulty experienced.

I want to say a word on the carbon question. I am interested to know whether anybody has succeeded in producing oxygen on carbon to any considerable extent without disintegrating it. I have had great difficulty, in my experiments with the secondary battery, in getting oxygen on my carbon plate, and depositing the oxide of lead. I have found, if I succeed in bringing forward the oxygen in the slightest degree, it leads to the disintegration of the carbon by means of the oxygen. Hydrogen does not do it at all. Now, if we place a carbon disk with a platinum disk in an ordinary Volckmar battery, we will soon discover how long that carbon will last. The oxygen seems to have the power of forming an accumulation in the pores, and crowding out the carbon, more than the hydrogen does. I dislike to have any thing to do with the lead-battery mentioned. I think that this matter of the copper-battery is worthy of passing mention, because I can see those cases arise in which we should like to have a battery that we could charge, and know we could depend upon, and that would not lose its charge even after two months. I am positive that anybody who tried it would be pleased with the properties of the copper-battery made in the usual way, with amalgamated zinc alkali, either soda or potash. Preference should be given to soda on account of its being so much cheaper. The method should be to use the Planté battery with chlorate of sodium in it. I think the tendency of the copper to dissolve, and to break up into cuprate forms, is not any greater when the soda is used.

Mr. Koyle. — I just wish to inquire of Professor Van Dyck how his carbon is made: it makes considerable difference. I should like to know the manner in which the carbon plates are formed. If they are formed by the ordinary method for use in the primary batteries, the carbon being made out of coal-tar carbonized, they are very brittle, and disintegrate in the battery; but if formed in the manner I speak of, from coal-tar, pure and simple, so that they seem to form a very much more homogeneous mass, there is not only a striking, but a permanent difference of the plates.

Professor Van Dyck. — I will state that I use the commercial carbon simply.

Mr. Koyle. — Another word. I think that there is a great deal of difference between the secondary

battery composed of carbon plates and one composed of lead plates. I do not see myself the reason for an expression of the opinion that the Planté battery is decidedly more scientific than any other batteries composed of a plate of polarizing substance distinct from a plate of lead. It is easy to construct a Faure battery that will last forever, if you only make the plates large enough. Lead has some weight, as is well known; and, when you are going to make a Planté battery of sufficient size to last any length of time, you will have to make a secondary battery of enormous weight. For any other purpose than putting it down in the cellar to stay, the weight is a great factor. I think that a lead plate a foot square, the ordinary size, will weigh something in the vicinity of six pounds, — I do not guarantee that exactly, but I believe it is in the neighborhood of six pounds, — and a square of carbon plate of the same size weighs about three-fourths of a pound. Now, a battery made of eleven plates of lead of this size gives you something like sixty or seventy pounds. If you want to use electromotive force, as in some cases you do, of a hundred volts, you have a great weight: it would be fifty of those cells, of sixty pounds each, which would give you about three thousand pounds; and that is altogether apart from the weight of the electrolyte and the box. Carbon plates will make a difference of about twenty per cent, and the carbon plate has the advantage of always remaining intact. It will not disintegrate, and will remain permanent as long as the box will, or any thing else about it.

Mr. Elihu Thompson. — I should like to have a method which will tell whether the plates will disintegrate or not. Consider the plates that received the deposition of peroxide of lead. Suppose we were to select one particle of oxide which has been formed from the surface of the lead: what will be the electro-chemical conditions of that particle? Evidently the peroxide itself is in an electro-negative condition, far more so than the lead plate: consequently it will set up an open circuit, and distribute its oxygen more or less to the surrounding lead, and thereby eat into the lead deeper and deeper, destroying the life of the battery in time. It would seem, from this consideration alone, that the lead-battery is certainly limited in its life.

Let us take the case of the carbon plates. Has it yet been proved that carbon is stable in the presence of peroxide of lead, in contact? Perhaps this may disintegrate the carbon, and oxidize it into oxide of carbon, and at the same time reduce the peroxide of lead to the teroxide of lead (PbO_3).

We have here two different substances, one highly electro-negative; and the carbon, perhaps, may be inert, and then it may be different in electromotive force ever so slightly, and we will have a local circuit which will take oxygen from the peroxide of lead, and oxidize the carbon. If we wish to make a test of that, let us take a massive piece of peroxide of lead and a specimen of the carbon which is to be tested, and place them in an electrolytic liquid (for instance, dilute sulphuric acid), and see whether we have a difference of electromotive force between

those two substances, putting in the circuit
means of testing a feeble current. If there
such difference, the stability of carbon in co
with the peroxide of lead would be establishe
may be, also, that the states in which carb
known to exist may control the matter to som
gree. It is well known, that if we take a sti
carbon, and put a current through it of a suff
degree to almost vaporize the carbon, it underg
certain change of condition into the graphitic va
and, in fact, it takes a plastic form, as I have
observed. You can take this carbon and use
any portion of it, to write with as you would
with a lead-pencil: whether it would be suital
that form is another question.

Professor James Dewar. — There is one po
have noticed that is of practical use in referen
secondary batteries, and that is as to the inequalit
the various styles of batteries. I have had an
rience of six months with one form of storag
tery, — the commercial battery as it is now in u
a lamp-circuit. As it is arranged, it is used for
ing forty incandescent lamps. We have only t
twelve of these lamps in use at any one time:
sequently the demand on the battery is not
great; and hence, in charging the battery, we
with a twenty-ampère current, which is the
rent used in charging them, that instead of h
to charge the battery all day, as I believe would
to be done in case the whole forty lamps were
used, we charge for two hours in the mornin
until the cells give off gas from the plates, whe
consider the charging as completed. I believe,
three weeks' use of this battery, that some fo
five of the cells that were to serve in the first
became feebler than usual; that is, the lamps
not up to their usual standard of power. The
morning it was found that certain of these
four or five of the twenty-one that formed the
tery, were much lower in their electromotive
than the other cells of the battery; that is to
if the mean of the electromotive force was 1.85
they were down to less than one volt. I
thought, in the first place, these cells might
haps, become exhausted by short circuits; but
very close examination, there were revealed no
circuits in the cells; and, furthermore, whe
charging current was put on again, those cell
the first of the whole battery to give evide
being charged. In other words, it would seem
the storage capacity, if I may use that expr
with regard to those cells — the storage capa
these particular cells had been diminished in
simple way.

Now, we restored those cells by a proc
the process which we were instructed to use
first place. A battery was first set up; that is
a prolonged charging of the whole body, — a ch
of some twenty hours with a current of twen
pères, and then a discharging of the whole batt
a fixed resistance, which was about equal to th
mate resistance (say, eight-tenths of an ohm)
a charge of twenty hours with a twenty-amp

nd again a discharging the battery for three or urs on this fixed resistance; then a re-charging nty hours; and at the end of that time the was in good condition again, and those par- cells which we had found had given out before give out again for several days; but in every think, where that process has been repeated r four times, it finally took about three weeks e batteries to give out. I don't remember ex- w whether the same cells are involved, but I hat out of the five or six cells, four were in- every time. We occasionally find another cell n the same way, and I think it is a question when all the cells will probably behave in the ay: otherwise the cells which are good, and have not given any trouble, are good cells; and s no doubt about the resistance of the whole The electromotive force is very constant, e exception which I mentioned, and the light satisfactory. But I am not at all sure that ece has found a solution of the light in ques- means of the secondary battery. It is to be hat he has. My experience rather indicates have not got a storage-battery, or a secondary which will be a practical instrument.

PREECE. — I should like to reply to some of ervations that have been made; and, in the ce, I should like to corroborate what has d about the percentage that the storage-bat- uld utilize in shape of light.

recently Professor Dewar was kind enough to calculation for me that brought out a very ing result, and the result was this. I wanted the relative proportion of energy expended ent modes of artificial illumination. I want- now how much was expended in the sperm- o give one-candle light, and how much in a e, and how much in electric lamps. The f Professor Dewar's calculation was to show a sperm-candle for one-candle light we ex- nety-seven watts. The experiment with gas that, for every candle given out, sixty-two ere consumed. Now, I have been experi- with various incandescent lamps; and one ve a result showing that it was possible to ne candle for two watts and half. Still with nination — use of arc-lights, such as are used treet — we get a candle for each watt ex- and in the arc-lamp, when bereft of the structure put around them to destroy or heir light, and we get all the light emitted, probably get a candle for each half-watt. an get one candle for the expenditure of one d we do expend ninety-seven watts in the it is clear that ninety-six watts must have sted, as it were, in that effect.

is another point that arises out of this, to want particularly to call your attention; I am afraid I am going to get into a subject , if introduced, many of you may set me down heterodox. My doctrine is simply this, — lieve the days of the arc-light are numbered, all the lights in the future will be furnished by the incandescent lights. My reason for saying that is simply this, — that, up to the present time, in the incandescent lamp such as we have, the light is produced by the expenditure of from four to five watts per candle. Improvements, and very rapid improvements, are being made in the form of the carbon filaments. We are now using lamps in England that give us light with an expenditure of only two watts and a half per candle. If improvement goes on at this rate, I am quite certain that before another decade we shall have incandescent light that will give us one candle for each watt. When that is the case, then the incandescent lamp will be used in place of the arc. The arc requires constant personal supervision. It requires mechanism to keep it in order. It only lasts a short time, whereas the incandescent requires no attention whatever after it is put up; and its life is very considerable indeed. In London, lamps can now be obtained whose life is guaranteed to be a thousand hours. I believe on this side of the water they are guaranteed to a certain extent, I do not know what; but if we can get incandescent lamps giving a light at the expenditure of a watt per candle, and whose life will be over a hundred hours, then it will be a case of good-by to the arc-lamps.

There was one other point that I did not mention in regard to my battery; and that was, I am using only seventeen cells. I am using only thirty volt lamps, and I use them for security, first, because it gives me very few cells to keep in order; and, secondly, because the electromotive force is so low that there is not the slightest fear of shock, and consequently there is not the least fear of fire due to a short circuit or imperfect action in any of the insulation. In isolated houses, the lower you can reduce the electromotive force, the safer it will be.

Now, with regard to carbon: I am sorry to say that I differ altogether from the view that has been expressed, that carbon is likely to replace lead for secondary batteries. Carbons do disintegrate with us in London to a very large extent in the present form of battery. I had the bi-chromate battery: the battery we principally use is a bi-chromate battery. In that battery the carbons do not last more than twelve months. They do disintegrate: they tumble to pieces, they become quite soft and spongy; and it is quite impossible to use any form of carbon, — moulded carbon; and we are obliged to use cut carbons, as the moulded carbons would not last more than two or three months. While the cut carbon does not last more than twelve months, the lead in the secondary batteries would last more than twelve months. I said that I did not agree with the remark that was made, the statement that it lasted only four months: I think it will last more than twelve months. I know of houses where they have been in use for more than twelve months, and I am quite satisfied that the lead used in the one I have described will have a durability of more than twelve months. I shall not be the least surprised if it lasts for two or three years.

Now, I look upon the employment of the secondary battery for starting the gas-engine as simply

barbarous. I say this because I believe that the whole — I should not say the whole, but the greater portion — of the causes that have brought the secondary batteries into such ill repute are due to the various barbarous practices that have been adopted by those who have been using secondary batteries. And these practices have been indulged in without the person knowing the injury they were doing to the battery. The practice has been to dash in a piece of metal in order to see the sparks, and then to say what splendid order the battery was in. A more iniquitous or sinful practice could not be adopted. It is just like a doctor cutting off a man's forehead to examine his tongue. Such a practice as that has given the poor battery a straight blow between the eyes, which it will struggle with for days. Any practice that constantly calls into action the force of the battery on such a short circuit is simply barbarous, and tends to destroy the battery more than any thing else. I test every cell of my battery every morning with a galvanometer of a hundred ohms resistance. The galvanometer is simply run through on the cells: it takes but a short time, and you can see exactly the condition of the cells without in any way interfering with the condition of your battery.

There is one point about which I should like to have Professor Dewar tell us a little something. There is one defect, and it is a very peculiar defect, in all of these forms of secondary batteries. It follows, after a short time, from covering the plate with minium, and it is the formation of trees on the plates. That formation is observable in that form and type of battery, and it is not being observed with the Planté. Planté himself has never suffered from the formation of trees; nor have I, in the batteries I am using, seen the slightest sign of these trees: therefore I think that the mode of separating, to prevent buckling, in my case will be a cure. It will not prevent treeing; and therefore it will not cure that defect, which is one of the most serious defects of the Faure battery.

Now, I will not say any thing about primary batteries. I mentioned, when first speaking, that there had been a good deal of interest expressed about secondary batteries and their introduction; but there has been none expressed about primary batteries. Such a battery as we have to-day has been brought before the London public; and it has been shown that the products of the battery formed in its action will repay the cost of the battery, and that the products can be sold for more than they cost: therefore it has been suggested, that, if it be true, it would be a splendid thing for the government to buy up all these batteries, and to use them, and in that way to pay off the national debt. A great many experiments have been made; and the results of these experiments are not to be discarded. They are successfully used for certain purposes, but they are not just yet going to knock out of the field secondary batteries in the way that has been described before us.

The qualities to which Professor Dewar referred are due to the impurities of the lamp. I have suffered somewhat in the same way. I have cured it precisely in the same way by putting on the power for twenty hours; and in that way the impurities, or whatever they may be, have been jostled out. The result has been, that this has had to be done about every two months, whenever there was a repetition of the difficulty. What I am going to do is this: I am going to have my battery in such order that I shall devote one day to the charging of the battery; and my gas-engine will be going all day long, and that will charge up my battery; and I shall have on that day sufficient storage-power to enable me to keep my house lighted for the rest of the week.

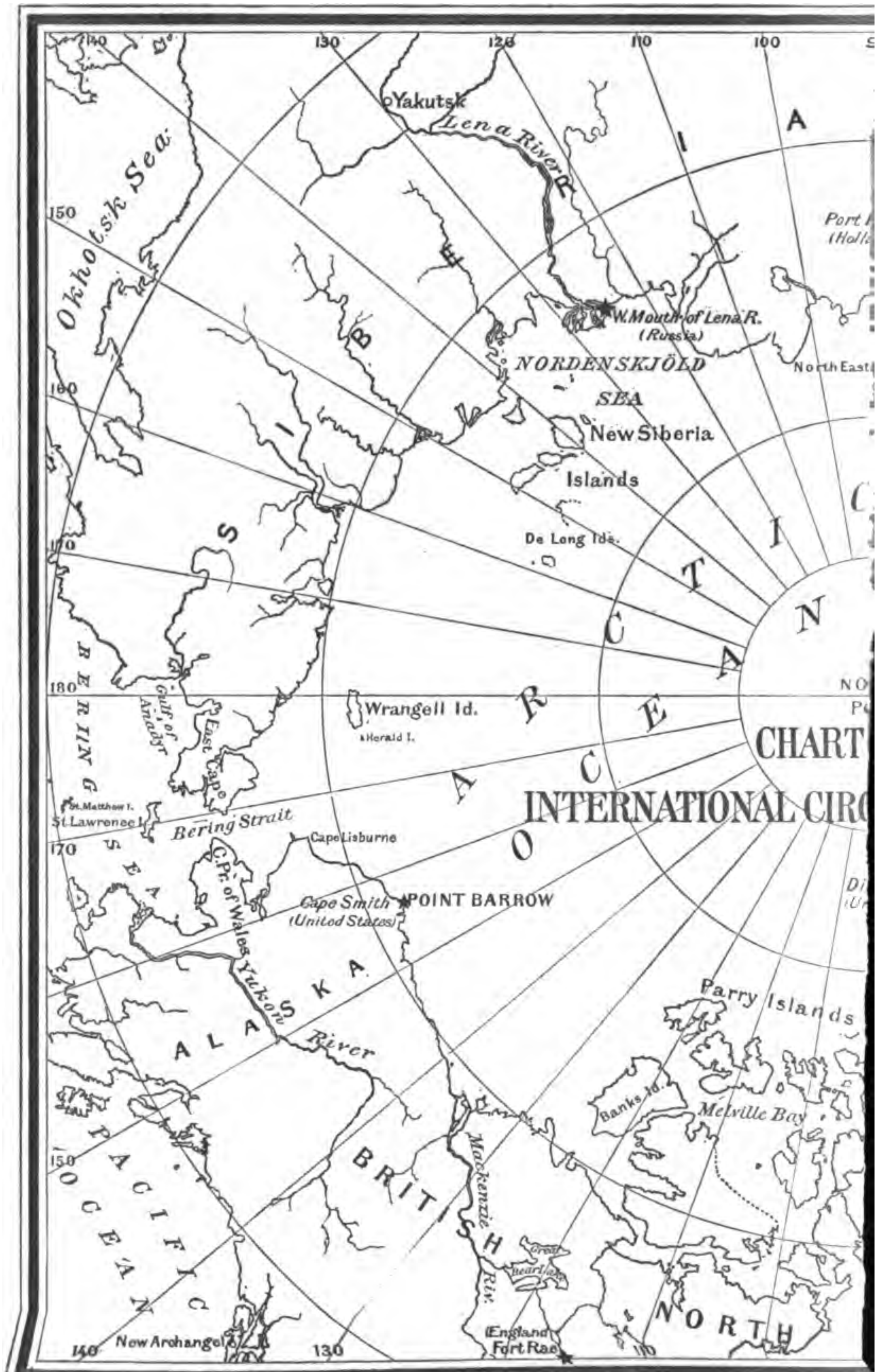
Professor James Dewar. — My views with respect to the chemistry of secondary batteries may be shortly expressed as follows: I feel that, in the future, some other body than the peroxide of lead will be discovered, which will more efficiently represent the amount of energy absorbed. I take it to be, that, after all, it is the question of the relative efficiency of such batteries which is the real question under discussion. The electrolytic action is, after all, the question we are to discuss. Now, it seems to me, apart altogether from the difficulties of local action, the question is whether any other chemical bodies likely to be formed during electrolysis will be as efficient as the peroxide of lead in the construction of secondary batteries. Let us take the case, then, of the type of these reactions. In ordinary cases of chemical action, we have often two actions taking place. Take, as an illustration, the formation of chlorate of potash. As a matter of fact, in this case an exothermic and an endothermic action take place side by side. The total action takes place, like the majority of chemical actions, with a considerable evolution of heat; but the evolution of heat is, in this case, due to the formation of the chloride of potassium, and not to the formation of the chlorate. A chlorate would be endothermic, would be minus, or there would be a reduction of the temperature during the production of such bodies: therefore the energy for the formation of the chlorate is really in some miraculous way extracted out of the energy produced by the direct formation of the chloride of potassium. The production of peroxide of hydrogen during electrolysis resembles that of the chlorate of potassium. It is endothermic, formed with a considerable absorption of energy, and consequently can decompose into water and oxygen again with an evolution of heat. If we could construct a battery in which all the oxygen is fixed in this way in an unstable body, there is no question but we could produce by this means a much higher electromotive force in secondary batteries. If we take the case of electrolysis of salts, we know very well, that, in a great majority of salts used for ordinary purposes, the electromotive force is practically constant, while that accords with the well-known fact, that the thermal value of the formation of the majority of soluble salts is nearly independent of both the acid and the base; that is to say, it is nearly constant, giving something like fifteen thousand gramme units per equivalent. For a direct battery, therefore, comprised of soluble oxide and soluble acid, the electromotive force is practically

in the cell, which is also attacked by the sulphuric acid, with the formation of sulphate of lead. We all know that sulphate of lead is a pretty fair insulator. I think the action pointed out by Professor Trowbridge in these cells, and the fact that there was a little sulphate formed during the operation of the cell; the fact that the cell is restored after this prolonged charging, in which, of course, there must be a great loss of energy; and the fact that they are restored to their original condition, — would induce me to believe that it is nothing due to the impurity in the lead, but rather is owing to the non-conducting film, which discolors the plate. Besides that, with regard to the short-circuiting, there is no short-circuiting in the cell. I am quite satisfied from attendant circumstances and observations, and from experiments that were made, that they saw no short-circuiting in the cells.

Before I leave this subject, I should like to say a word or two with regard to the hope that Professor Preece indulged in. I am glad that he has had such an encouraging experience with regard to storage-batteries. I am inclined to think he will be disappointed in the hope expressed, of being able to charge the cells on one day of the week, and then use them during the rest of the week. A very simple calculation would convince him, as well as the conference, that such a plan is not practicable with his present plant. Perhaps, if he increases his plant, he may be able to do it: he cannot do it with what he has on hand. If we take the figures as Professor Preece has given them, of a candle from 2½ watts of energy, a 16-candle lamp would require 40 watts, and that gives us an efficiency of about 18.6,—16-candle lamps per horse-power of candle-energy, which I must say, in the first place, is good lighting. 40 watts, with 30 volts between its terminals, will give us 31.3 ampères as the current to the lamp. Now, if we suppose that Mr. Preece has, in using 10 lamps, for instance, — I do not know how many there are in the plant used; we will say 10 lamps; put the number small, because 10 lamps are enough for ordinary use, — 10 lamps would require 13 ampères to maintain them. 13 ampères for 3 hours would be 39 ampère hours, we will call it, on an average night, and, for seven nights in the week, would be 273 ampère hours. Now, we divide 273 by the efficiency of the storage-batteries, — forty per cent, — and we will get as the total number of ampère hours, during which the battery must be charged, 682½. If we divide that by the number of hours which the charging would occupy, — twelve hours during the day, — that will give us the time used in charging the storage-battery, to produce this result, and give the current to the storage-battery of 56.9 ampères and 42 volts; in other words, 52 ampères to .8 of an ohm. The charging resistance of the battery would certainly be greater than .8 of an ohm. I call the charging resistance of the battery the difference of tension between the terminals of the battery, while the battery is being charged at the time by the current flowing in the circuit. That is what I designate by the term 'the charging resistance.' The charging resistance I am sure, from my own experiments, cannot be less than 2 ohms. Second, The current of his machine would be very materially reduced. Besides that, admitting that he could get this current of merely 57 ampères, which he requires for charging the battery, the question is, How long would his cell stand a current of that magnitude? I am inclined to think that a very few weeks' charging with a current as great as that would very soon use up his cells.

Mr. PREECE. — The assumption of the temperature he starts with there, is wrong; for I am only using ten-candle lamps, and they absorb nine-tenths of an ampère. If you go through with a calculation on paper, you are sure to make a mistake. My calculation shows that you can get two hundred ampère hours out of my battery: if so, I shall have enough to last me a whole week; and the batteries, I am quite sure, after they have been used a little time, will give me that, and a margin to spare. I am quite certain, notwithstanding those figures that I had the pleasure of going over, that I shall be able to report, that, from one day's charging, I have got my light for a week.

I will mention one fact, which I mentioned to you this morning, that my gardener cut off the top of his foot: at that time my battery was charged up Friday morning. I had a dinner-party Friday night; and whenever we have dinner-parties we make all the show we can. On Saturday I had no dinner-party, and I used my lamps as usual. On Sunday I used my lights as usual. On Monday morning my man cut off his toe. I had a dinner-party on Monday night, and I did not know of the accident at all. I got down just in time to dress for dinner. Without saying a word to anybody, I trusted to my battery: and I found my battery held on for the whole of that night. I had, without any further attention to the battery, sufficient light for two dinner-parties and four days. And I think if we did that in an emergency, with a little gentle care that could be given, I shall not be far wrong in saying that I shall have enough for a week's use.



Okhotsk Sea
Yakutsk
Lena River
S I B E R I A
W. Mouth of Lena R.
(Russia)
NORDENSKJÖLD
SEA
New Siberia
Islands
De Long Ids.
A R C T I C
O C E A N
Wrangell Id.
Herald I.
CHART
Gulf of Anadyr
East Cape
B E R I N G
S E A
St. Matthew I.
St. Lawrence I.
Bering Strait
Cape Lisburne
C. Pr. of Wales
Cape Smith
(United States)
POINT BARROW
A L A S K A
Yukon
River
P A C I F I C
O C E A N
B R I T I S H
Mackenzie
Riv.
Great
Bear Lake
(England)
Fort Rae
N O R T H
New Archangel
Parry Islands
Banks Id.
Melville Bay
140
130
120
110
100
150
160
170
180

SCIENCE.

FRIDAY, OCTOBER 24, 1884.

COMMENT AND CRITICISM.

PROFESSOR COTTERILL, in an appendix to his new 'Applied mechanics,' describes the organization of the school of engineering in the Royal naval college at Greenwich. He states that the training of the students in the practice of naval architecture and of engineering takes place in the dockyards before entering the college, and during the three summer months in which the college is closed. For such training he considers the college-workshop a very imperfect substitute, and that it occupies time 'which may be better spent elsewhere.' He further deprecates the use of models in teaching such students, remarking that the engineer does not use models, but drawings. He considers that models are of little value for such purposes, and would even condemn their use to demonstrate the laws of motion. He is, however, in favor of their use in explaining mechanical principles. Professor Cotterill approves of the 'mechanical laboratory' in which experimental investigation can be carried on, and in which mechanics can be studied experimentally. He also would allow the use of the school-workshop in the 'lower grades of technical instruction.'

These views of so distinguished and experienced an educator will probably attract much attention from those who are engaged in similar work. It is a question, however, whether they will be very generally indorsed in this country, or indeed in any European country, if we may judge from the fact that the methods which he condemns are those which are most rapidly coming into use on both sides the Atlantic. In the discussion which took place in section D of the American association at Philadelphia, there seemed to be no difference of opinion on this point. All were apparently agreed that the school-workshop is the place in which the student should learn the use of the tools in the several trades, and that systematic instruction there is vastly more profitable than any that the best of shops engaged in purely commercial work can give. There may, however, be some question whether the same systematic instruction in the large shop or in the dockyards ('navy-yards') might not be still more fruitful and profitable. The only point which seemed to be thought important as a question to be settled, in the discussion referred to, was the relative value of the workshop conducted purely as a classroom and that in which a certain amount of commercial work is constantly carried on.

THE U. S. artillery school at Fort Monroe has the following paragraph among its recently approved regulations: "To the end that the school shall keep pace with professional progress, it is made the duty of instructors and assistant instructors to prepare and arrange, in accordance with the programme of instruction, the subject-matter of the courses of study committed to their charge. The same shall be submitted to the staff; and, after approval by that body, the same shall become the authorized text-books of the school, be printed at the school, issued, and adhered to as such." If all the courses of study in the school were strictly technical, or if all the instructors there were eminent specialists, this plan of fostering home products would doubtless work to the advantage of the students; but in such subjects as geology, botany, or zoölogy, in which the ordinary forms of instruction cannot be improved by special adaptation to artillery practice, we believe that nothing is gained by neglecting to use the generally approved text-books of the science. The work on geology lately published by the school does not dispel this belief.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

American geological railway-guide.

I HAVE commenced revising my geological railway-guide for a second and much improved edition. I should be glad if persons who have used the book, and made notes of corrections and additions, would send such corrections or additions to me; or, if it will be a saving of labor, it will be a great favor to me if they will send me their copies of the book by mail; and I will return them, and refund all postage.

JAMES MACFARLANE.

Towanda, Penn.

A wider use of scientific libraries.

In *Science* for Oct. 3, your editorial calls attention to the need of making scientific libraries more widely useful. Perhaps some of your readers will be glad to know the liberal policy of the Boston society of natural history. The society is willing to send such books as can be replaced, to students in any part of the country, at their expense of course; asking from strangers a deposit of twice the market-value of the books sent, as a guaranty against loss. This is an example which may well be followed by all such libraries.

EDWARD BURGESS. [illegible]

Boston, Oct. [illegible]

Eye-pieces of the meridian circle at Washburn observatory.

In vol. [illegible] of the Publications of the Washburn observatory, p. [illegible] [illegible] said that the eye-pieces furnished by [illegible] Messrs. Repsold of Hamburg with our meridian [illegible] [illegible] [illegible] [illegible] from the firm of [illegible] [illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The meeting was not marked by any paper of exceptional importance; but most of them were of general interest, and provoked extended discussion. Perhaps that which awakened the liveliest interest was the one in which Dr. E. B. Tylor of Oxford, who addressed the academy by request, gave his observations upon our native tribes, and called attention to the parallelism of their customs and those of widely distant races. He dwelt at length upon the distinction which should be drawn between the origin of identical customs in separate groups of men, some of which are due to the descent of such groups from one primordial stock, and some have arisen spontaneously from similar psychic conditions. To the former, Ray Lankester had applied the term 'homogeny,' and, to the latter, 'homoplasy.' He asked the academy to tell him to which class so complicated a symbol as the pentagram belonged, which is used both by the Indians and the Asiatic astrologers. Professor Hilgard thought that such a symbol would arise spontaneously, as only in that form could a stellar figure be produced by the use of one continuous line. Major Powell believed that a third class should be added, to include arts and customs borrowed from neighbors, — a class which he was accustomed to call 'origin by acculturation.'

Among the physical papers, astronomy, as usual, held a leading place. Professor Langley offered the academy a continuation of his observations on the temperature of the moon's surface, as studied by the bolometer, showing that it must be even lower than two hundred degrees below zero, Centigrade. Professor Valentiner of Carlsruhe, by invitation of the academy, gave in his own language an account of the meridian-work he intended to undertake at the observatory, recently removed from Mannheim, and the installation of which would be completed by the middle of next year. His principal work was to be the observation of all stars up to the eighth magnitude, between the equator and 20° south latitude, and he hoped to accomplish the task in twelve years. Dr. Peters of Clinton stated what progress he had made in determining the stars in the star-catalogue of Ptolemy's Almagest, and gave a very interesting account of his studies of the manuscripts extant, and the errors which had crept into them, exhibiting photographs of some [illegible].

Mr. C. S. Peirce explained some of the [illegible] still needing correction in pendulum observations, particularly such as were due to the flexure of the pendulum. He presented the outline of a scheme for a gravitation sur

ie entire country, indicating the posi-points in the eastern portion of the which he thought most desirable to in which the stations would be about red miles apart, regions of geological ice avoided, but their sides occupied, with the summits of the higher moun-seven or eight stations could be occu-a year, and thus a series of curves which would give us the form of the .e., of the surface beneath the conti-re the force of gravity was uniform.

interesting communication on the atomic volumes, Dr. Wolcott Gibbs e point that writers had left out of ation the volume of the interstitial Mr. Fairman Rogers described some eatures of Grant's difference-engine, that, by its method of calculating y successive differences, it was an nent on previous arithmometers, elimi-any sources of error. Those present used such calculating machines be-em to be more useful in mathematical astronomical work.

pers other than physical, much in-tached to the exhibition, by Mr. Pum-the first attempt to obtain a composite ph of the members of the academy. ne photographs were obtained at the meeting of the academy; and three es had been made from the full-face -one in which all were represented, in which the physicists and naturalists n separately combined. The latter ved marked differences, the physicists a much more oval face, and greater breadth. The common composite, s the others, had a far more youthful ice than any of the pictures from which re taken: only four or five at all ap-l them in this respect. Messrs. Peirce trow's experiments on the question, there is such a thing as a minimum ble difference of sensation, or what mans call *differenzschwelle*, were in-. The experimenter arranged for the on, by an assistant, of successive dif-of pressure upon the surface of his ly, so slight that he was unable, so e himself could judge, to either hear, or even feel them; but actually, in ority of cases, determined correctly the change was positive or negative.

rely zoölogical papers there were few. by Professor Verrill gave an account present season's work of the U. S. mission, which, by the steamer Albatross, continues to bring from the deep sea additional forms of animal life new to science, and in great numbers. The most unexpected result is the finding, in some of the deepest dredgings, of large masses of exceedingly compact clay, instead of the usual globigerina and other ooze. Dr. Packard showed, that, in a blind isopod crustacean from the Mammoth Cave, the brain differed from its allies only in that traces of the pigment-layers of the eye remained more or less developed after the entire abortion of the optic lobes and nerve. Professor Cope believed he had found the probable ancestors of the Mammalia in the Pelycosauria, — an extinct type of reptiles, which, of all reptilian types, shows at once the most distinct batrachian and mammalian features.

Major Powell gave a succinct account of the operations of the U. S. geological survey, exhibiting two copies of the land-office map of the country, — one colored to show the regions which had been occupied; the other, the broader features of its geology. Mr. Pumpelly gave a similar account of the work of the recently closed Northern transcontinental survey, and a special notice of the mesozoic coals met with in that survey. By the study of transverse and cross sections of the crystalline tufa of Nevada, Prof. E. S. Dana was able to determine that the original form of thinolite was a steep pyramid: it was probably a chloro-carbonate of calcium, now altered to calcium carbonate. Professor Brewer stated that in the dry regions of the west, especially when several dry seasons followed a succession of moister ones, in which the lands were overstocked, the nutritious grasses were eaten to death by cattle, and thereupon supplanted by noxious types. Several were mentioned as producing a rapid obliteration of our native pastures, and their seeds as injurious by piercing the skin, and producing sores.

Two reports called for by the government had been transmitted to the president of the academy, and will form a part of his annual report to congress, — one upon the organization of the scientific bureaus of the government, called for by the commission, whose appointment we noticed in the first number of this volume; the other upon the proper classification of philosophical instruments under the existing tariff regulations, called for by the secretary of the treasury. A second quarto volume of memoirs was announced as in the hands of the binder.

The next session of the academy will be its annual meeting, next May, in Washington.

DEATH AND INDIVIDUALITY.

THE current conceptions of death as a biological phenomenon are very confused and unscientific. In this essay I shall endeavor to analyze the problem, and, by placing the factors concerned in a clearer light, to diminish the obscurity in which the subject is still involved. This appears to me the more desirable, because the recent publications of Weismann and Goette upon this general topic have increased rather than lessened the existing confusion. In fact, these authors fail to make the necessary distinctions between the different kinds of death, the different orders of individuality, and the different forms of reproduction. This assertion is, I believe, justified by the following paragraphs: —

First, as regards individuality. Individuality, as it is generally understood (i.e., as something always equivalent to itself), does not exist in nature, except subjectively as a rather fantastic notion of the human mind. The term 'individual' is applied to things utterly incommensurate with one another. An individual protozoon, an individual polyp, and an individual insect, are not homologous and comparable bodies. It is mere slavery to a false form of speech to imagine that their 'individuality' is a common quality; for, on the contrary, the same word indicates here three distinct phases. I know not how to account for the immense significance attributed to the mystical idea of individuality, which in reality corresponds only to a physiological capacity for a separate existence, but in usage is tacitly assumed to be the name of some vague fundamental property of life, which, however, the mind cannot apprehend. Now, we have renounced considering a wing in a bee, a bird, or a bat, as identical or homologous with every wing, either on account of its name or its function. But, although the different kinds of individuals of animals and plants are much more unlike one another than are the manifold types of wings, yet individuality is generally taken to mean a uniformly identical something; and that is untrue. Of course, the matter is really very simple, and indeed self-evident, as to its true nature; and the singular obscurity prevailing is probably due only to the problem not having been clearly thought over. At present the condition of opinion upon the subject reminds one of the ancient notions of beauty, according to which, beauty was an inherent quality of objects, not an impression of the mind, a psychological state. Despite custom, it is plain that 'individual' has many meanings; yet it is usual to compare 'individuals' with one another throughout the animal kingdom. This error has been repeated by Weismann and Goette, because they both assume that the death of a single protozoon is equivalent to the death of one of the higher animals. Goette, however, has partially emancipated himself from this idea, which I believe to be erroneous. The death of a unicellular, is entirely different from the death of a multicellular, individual.

To Huxley[1] we owe the first scientific determination of individuality. His essay on the subject ought to be thoroughly studied by every biologist. Life occurs in cycles of cells; *each cycle comprises all the cells springing from a single impregnated ovum;* the whole of every cycle is homologous with every other whole cycle, no matter whether every cell is a so-called individual, or whether they constitute several individuals (e.g., polyps) or a single one (vertebrates). *All cells are homologous, all cycles are homologous; but individuals are not always homologous*, since an individual may be either the whole or any fractional part of a cycle. This question I have discussed a little more fully on pp. 191, 192, of my article cited in the footnote.[2] Manifestly the death of the single cell is not necessarily identical with the termination of a cycle. Now, when a man, he being a cycle of cells, has lost the ability to continue the cycle, he (or it) dies. Further, it is inherent in his constitution to lose that ability gradually: hence, when it is completely lost from internal causes, he dies, as we say, from old age. It is to this ending-off of the cycle, from causes resident in itself, I wish to restrict the term 'natural death.'

We have now two questions to pose: 1°. Do all organisms belong to cell-cycles? 2°. If so, are all cycles self-limited? In common language, the second question would be, Is death always the natural and inevitable accompaniment of life? — an inquiry which may appear singular, but is none the less perfectly sensible and legitimate. Weismann has answered it with a negative.

1°. I maintain the hypothesis that all organisms do develop in cycles, and only in cycles; which involves the assumption that all living species begin their life-history with an impregnated ovum or its equivalent. We come, therefore, at once to the question of

[1] T. H. Huxley (1852) upon animal individuality, *Royal inst. proc.*, i. 184-189; *Edinb. new phil. journ.*, liii. 172-177; *Ann. mag. nat. hist.*, 1852.

[2] C. S. Minot (1879), Growth as a function of cells, *Proc. Boston soc. nat. hist.*, xx. 190-201.

sexual reproduction extends down- the scale of life. I deem it very that it extends to the lowest animat- , even though it be quite differently ed in the lower forms from what we in ordinary bi-sexual reproduction. y is opposed to the opinions generally r botanists trace the evolution of sex e vegetable kingdom; and zoölogists though less definitely, within the ani- dom. We are thus forced to assume , one of the most fundamental and ristic phenomena of life, has arisen This is to the last degree improbable. oincidence would be the most extraor- esult of chance within human experi- t is more reasonable to suppose, that, re do not yet recognize it, the sexual exists in the protobionts, which are animal nor vegetable, and that they luce a body homologous with an im- d ovum; and to suppose, further, that, is common commencement, both ani- vegetable sex have been evolved. The property of the sexually produced its power of repeated division, pro- succession of cell-generations, which, with the original body (*ovum*), con- e cycle. There is much evidence of e character to confirm the belief of cal course of life, even among the pro- d protophytes, in which there occurs known as rejuvenation (*verjüngung*). maintain that it is probable that all f cells are self-limited. Let us first the nature of the limitation. Our ge of the manner in which the cycles ted (i.e., of the causes of natural s very restricted, and derived solely higher animals. My own special in- ons have been in this field, and have to the opinions and problems we are g.

xperiments demonstrate, that, when analyzed, the growth of at least the nimals gradually diminishes from birth , almost without interruption. This efutable mathematical verification of s which I advanced in my article on as a function of cells,' published in e essence of which, as far as we are cerned, is, that the cells of a cycle usly lose their power of division, so interval between two successive divis- dually increases. This involves the termination of the cycle, because the o on, not only until the cells can no ivide, but until they exhaust themselves. This whole series of changes is properly *senescence*, or growing old. Senescence is a continuous process, covering the whole period of a cycle of cells; and we must assume it is the positive loss of power in the single cells, such that the last-produced cells cannot continue, and *natural death* ensues. Of course, in the cases of a multicellular animal, death of the whole follows secondarily upon exhaustion of any essential part; as in the case of insects, which die upon laying their eggs. In the higher animals, then, the cycle is limited by senescence, and senescence is a decay which probably begins when the cycle begins. The next point to decide is, whether the same phenomenon occurs with the unicellular organisms. If it is found that the divisions of a Paramecium,[1] for instance, after a conjugation, are at first rapid, and then follow at increasing intervals, it would prove (provided, always, the external conditions remained constant) that we here had true senescence, with its sequel, natural death, or the end of the cycle. Until this point is settled, we cannot know whether there is, among unicellular animals, a form of death homologous with the natural death from senescence in the higher animals and plants.

It is to be regretted that both Weismann and Goette appear not to know the article to which reference has just been made: otherwise they would have recognized that the problem of death is, *first*, whether growing old (*veraltung*, *involution*) is a universal phenomenon of life. Weismann's first article was an address delivered before the German naturforscherversammlung, September, 1881, and subsequently republished at Jena.[2] He advanced then the view, that, for unicellular organisms, there is no death except through accident; that, the propagation being by simple division, we must assume that the process of division may go on forever. He does not even consider whether the cells form cycles, and whether these cycles need to be renewed; so that he misses the real problem. On the contrary, he is enchained a prisoner to the mystical idea of individuality, and reasons as if individuality rendered direct comparisons legitimate between things essentially different. All his reasoning is based upon the idea that an individual protozoan is comparable to an individual dog, and so on. The argument just made against him was to show that the basis of his whole fabric is illusory. Bütschli, in his short article,[1] called forth

[1] Paramecium is a common unicellular animal.

[2] Weismann, Ueber die dauer des lebens (Jena, 1882, 8°), 94 p. Cf. also Weismann's comments on Bütschli, *Zool. anzeiger*, v. 377–380, and his reply to Göette, — Ueber leben und tod (Jena, 1884, 8°).

by Weismann's, partially liberates himself from the confusion as to individuality, and propounds the hypothesis of a *lebensferment*, which he supposes to be continually renewed in protozoa, which he thus assumes to be potentially immortal. He also fails to recognize that the true question is, not whether single protozoa die, but whether they form senescent cycles. In this error he is followed by Cholodowsky,[2] who also admits that natural death is restricted to the multicellular animals, but overlooks what would be its only possible homologue among protozoa.

Goette seems to me to have made a distinct advance beyond his predecessors, for he has attempted[3] to show that there is a death common to all organisms. Especially is his conclusion that death and reproduction are intimately connected to be noted as important; but his thought appears to me often vague and obscure, and to many of his views I can by no means assent. I have just asserted that death and reproduction are intimately connected. Now, if my theory is correct, it is evident that each cycle, before it is completely exhausted, must produce the initials of new cycles: hence the connection in time between maturity, or the approach of death, and sexual reproduction. By speculation upon the few available facts, I have reached the following hypothesis. Originally each cell of a cycle was a distinct individual; the exhaustion of the last cells of the cycle *caused* them to become sexual bodies and to conjugate; conjugation renews the power of division in the conjugated individuals, and therewith a new cycle is begun. Subsequently multicellular animals were evolved, and in these the same phenomena recur; but some of the cells have become specially organized, and thereby incapable of assuming the sexual state: hence, when the end of the cycle approaches, only a few cells become sexual, and the animal (or plant) is mature. The higher organisms become sexually active only after having grown for a considerable period, because they still preserve the primitive relation. Senility is the *auslösende reiz* of sexual reproduction. I hope to discuss the matter fully in a memoir which I am now preparing for the press.

It is evident, that, according to this hypothesis, sexual reproduction depends on the exhaustion of the cells. There are many facts known to confirm this view. Thus among men the reproductive period begins sooner when they are ill fed. Among many of the lower plants, reproduction is induced by defective nutrition. I believe that nutrition and reproduction are, indeed, opposed to one another, but by no means in the sense taken by Carpenter[1] and Spencer.[2] While I consider that the impaired nutrition causes the effort to reproduce, they believe that reproduction is opposed to nutrition, constituting a tax which withdraws just so much from the parent. Undoubtedly, in those cases where the parent, in consequence of a secondary addition to the office of genesis, has to supply food to its young, reproduction may detract from growth, but, even in such cases, only sometimes. Carpenter and Spencer's whole argument rests upon the assumption that the power of assimilation is only just equal, or about equal, to the demands of the parent. It is, however, perfectly well known that the reverse is true, and that there is in most organisms a large surplus of assimilation possible, which is used whenever the functions demand it: hence in most cases the secondary taxes of reproduction can be wholly or mainly paid without calling on the growth capital of the parent. Spencer's *a priori* argumentation I consider superficial: it has led him to an exaggerated idea of an opposition which exists in nature, but is not general. Moreover, Spencer has mistaken the cart for the horse: animals do not stop growing because they begin to reproduce, but they begin to reproduce because they stop growing: or, more strictly speaking, both events are due to one cause, — senescence.

It will be seen, upon reviewing the preceding paragraphs, that the views I advocate are opposed to all the other opinions upon the nature of death which have been noticed above. In a memoir I am now at work upon, I hope to array a large number of observations to defend the theory outlined in this essay.

C. S. MINOT.

[1] O. Bütschli (1882), Gedanken ueber leben und tod. *Zool. anzeiger*, v. 64–67.

[2] N. Cholodowsky (1882), Tod und unsterblichkeit in der thierwelt. *Zool. anzeiger*, v. 264, 265.

[3] A. Goette (1883), Ueber den ursprung des todes (Hamburg and Leipzig, 1883, 8°), p. 81.

[1] William B. Carpenter, Principles of physiology, general and comparative (3d ed., 1851), p. 592.

[2] H. Spencer, The principles of biology, vol. ii. pt. vi.

AMERICAN APPLIANCES FOR DEEP-SEA INVESTIGATION.

The wire dredge-rope.

IT was a revolution in deep-sea dredging methods, when the cumbersome hempen rope was discarded for one of wire, measuring scarcely more than one-third the same diameter, stronger, more durable, and less expensive. The introduction of wire-rope will not affect

rests of the small-boat dredger; nor material be used to advantage without of steam, but the active competition sting with regard to deep-sea explora- ist needs render its adoption necessary rge expeditions.

rope was employed in all deep-sea s up to the winter of 1877–78. One ost serious objections to its use is the of space it occupies, especially when, e case of the Challenger, twenty-five l fathoms are carried. On the Por- only three thousand fathoms of two- lf and two-inch rope, weighing about hundred pounds, were supplied; but convenient storage and handling of e was required a row of twenty great , about two-and-a-half feet in length, g over one side of the quarter-deck top of the bulwark.

far greater objection to hemp-rope is h of time required in making a deep- lging with it, as experi- y Sir Wyville Thomson, other deep-sea dredgers the past few years. In Porcupine dredged in the Biscay, in a depth of 2,435 requiring some ten hours haul. On the Chal- entire day would be con- dredging or trawling in f from two thousand to ve hundred fathoms.

e utilization of steel-wire rope for dredging, we are indebted to the suggestion of Professor Alexander who first recommended its use; and nander Sigsbee, U.S.N., who prac- emonstrated its superiority over all ds of dredging-rope, and perfected the of handling it. The first trials were the coast-survey steamer Blake, in the Gulf of Mexico, in the winter 78. The size of rope then selected, employed by both the coast survey ommission, measures only 1⅛ inches[1] ference, and has an ultimate strength lbs. The chief advantages of wire he words of Mr. Sigsbee, are "com- strength, durability, neatness, facil- dling with a small force, celerity of s, and economy." The entire amount o make the deepest dredging can be on a single drum which occupies but picuous position on the deck. But few men are required for the operations of dredging; and the reeling-in can be performed, in case of necessity, by two men only, one standing at the hoisting-engine, the other at the reel.

[1] [illegible] inches has also been successfully tried.

Where the dredgings are confined to depths less than a thousand fathoms, as was the case with the steamer Fish Hawk, the hoisting-engine may be dispensed with, and the rope led directly to the reel, which can be made sufficiently strong to withstand the strain put upon it in using so small a quantity of rope. With operations simplified to this extent, a single man can control both the lowering and the reeling-in; the additional help being required only to handle the dredging apparatus on the deck, and to start it on its downward passage.

As to economy of time, the wire rope has a decided advantage over hemp or manila. Sir Wyville Thomson states that

> "There can be no doubt that in any future expedition, on whatever scale, it would be an unjustifiable waste of time and space to neglect the use of wire for sounding, and wire rope for dredging and trawling; but it seems to me that even the use of these should be simplified, and not made more complex."

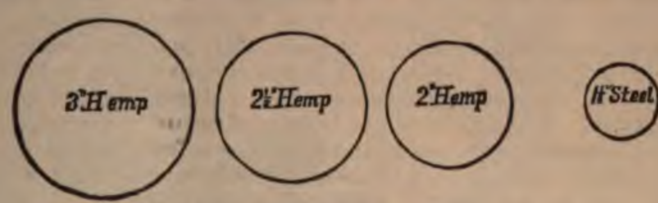


FIG. 1. — COMPARATIVE SIZE OF DREDGE-ROPES.
(*From Sigsbee's 'Deep-sea sounding.'*)

Prof. H. N. Moseley has been even more generous in his acknowledgments; and in a lecture on deep-sea dredging, delivered before the Royal institution of London in 1880, and published in *Nature* for April 8 of the same year, he spoke of the advantages of wire rope, which have already been alluded to.

Accessories to wire rope.

Among the important accessories to the use of wire dredge-rope, which have been introduced in this country, may be mentioned an improved form of accumulator, a set of safety-hooks for attaching the trawls, and several patterns of dredging-blocks.

The Sigsbee accumulator (fig. 3), which replaces the pattern formerly employed by the English, and which has since been adopted on the French steamer Talisman, was first used

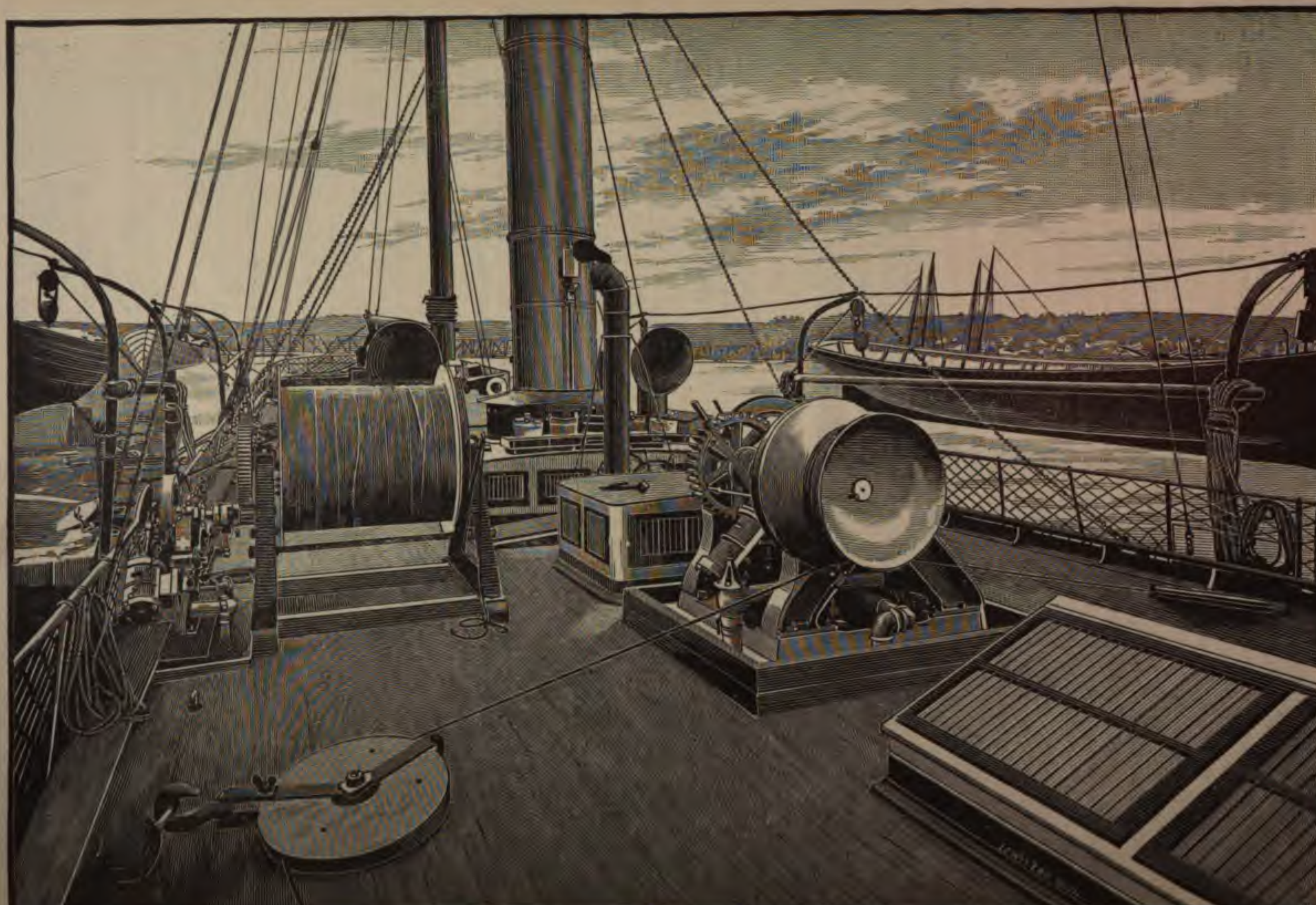


FIG. 4.—VIEW OF THE DECK OF THE BLAKE, READY FOR DREDGING.
(From Sigsbee's "Deep-sea sounding.")

[t]he steamer Blake, in 1878. It consists of [a nu]mber (26 to 37) of rubber car-buffers, ar[rang]ed for compression on a central rod, and [sepa]rated from one another by thin brass guide [plat]es provided with hubs or fillets, which [prev]ent the buffers from coming in contact with [the] rod. Under strain applied at the lower [end] the accumulator elongates, and when re[liev]ed from strain is restored to its former [leng]th by the elasticity of the buffers. The

[FIG.] 3. — SIGSBEE'S ACCU[MU]LATOR FOR DEEP-SEA [D]REDGING, WITH DREDGE-[B]LOCK ATTACHED.

FIG. 4. — THE SAFETY-HOOKS FOR ATTACHING THE BEAM-TRAWL TO THE DRAG-ROPE. SHOWN IN DETAIL.

[amo]unt of extension afforded by the Blake's [accu]mulator was six feet, which, according to [the] experience of Commander Sigsbee, is quite [suffi]cient; the principal purpose of an accu[mula]tor being to indicate the amount of strain [afte]r fouling, and when the dredge-rope has [bee]n hauled tight and is nearly vertical. The [Eng]lish accumulator, consisting of a number of [...] elastic rods, was intended to relieve the strain upon the rope in case of fouling.

[T]he safety-hooks (fig. 4) invented by Capt. [...]ner, U.S.N., are an ingenious device for releasing the beam-trawl in case of its fouling irretrievably, and thus relieving the strain upon the rope which might otherwise break at some distance above the bottom, thereby entailing an additional loss of rope. They consist of a stout steel spring enclosed in an iron cylinder, and controlling the opening and closing of a pair of heavy iron hooks, which project from one end, and can be adjusted to detach at any point between three thousand and six thousand pounds.

Commander Sigsbee first improved the dredging-blocks. In the deck-blocks, the side plates are free to revolve; but in that which hangs pendent from the boom end, they are pinned to the strap, and connected by socket-bolts, which are intended to prevent the dredge-rope from getting between the side plates and the strap. The dredging-blocks supplied to the Albatross have no side plates; and the sheave, which is of brass, revolves on a series of brass friction-rods surrounding the steel pin or axis.

Sieves.

Convenient sieves for working over the mixed materials after they have been landed upon the deck are very important adjuncts to the dredging work.

The larger proportion of the contents of the dredge and trawl frequently consists of mud or sand, which requires to be washed from the specimens before they can be preserved or studied. Many different devices to accomplish this sifting or washing have been tried, both in this country and in Europe: but of those now employed by the Fish-commission, only one has been borrowed; the others, two in number, having originated with this survey. The three patterns of sieves are intended for different purposes. The simplest is a nest of circular sieves similar to those figured in Sir Wyville Thomson's 'Depths of the sea,' and used for sifting small quantities of material by hand, in a bucket or tub of water.

The rocker or cradle sieve (fig. 5) is designed especially for washing the contents of the dredges; and the table sieves, for the great mass of material which so often comes up in the trawl; but the latter has been found so useful for all kinds of work that it is now most commonly employed, especially as it forms in itself a large and convenient sorting-table around which a number of persons can stand at a time. The cradle sieve was devised by Professor Verrill in 1872, to afford the means of rapid washing over the side of the vessel. It is semicylindrical in shape, the curved bottom and sides consisting of two thicknesses of

wire netting; the lower having a strong and coarse mesh, and designed to give strength to the upper netting which determines the size of material which can be washed through. The end pieces are of wood. A rectangular box fitting into the top of this sieve, and having a coarse wire bottom, is sometimes employed for the purpose described below in the next pattern. The table sieve was the joint invention of Professor Verrill and Capt. Chester in 1877, and was originally intended to receive the contents of the trawl which had been previously dumped upon the deck. It consists of a large rectangular wooden frame, supported upon legs of a convenient height, and with a bottom of heavy galvanized wire-netting which serves to support the real bottom of the sieve. This is of fine wire-netting fitted to a removable frame. Above this is a second, hopper-shaped frame-work, covered underneath with

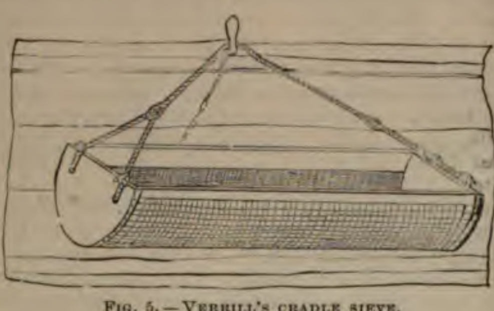


FIG. 5.—VERRILL'S CRADLE SIEVE.

coarse netting, and provided at about the middle of the side with cleats which rest upon the upper edges of the main frame when the three frames are nested together for use. The trawls are emptied into the hopper frame, which retains the coarser objects, allowing the smaller and generally more delicate specimens to be washed out on to the finer netting below. This arrangement of sieves has been found to give greater satisfaction than any other for washing large quantities of material, and keeps the specimens in better condition. The under part of the main frame is covered with heavy canvas, which serves to direct the water to the canvas tube in the centre, and thence over the side of the vessel.

Mr. James E. Benedict, naturalist on the steamer Albatross, has recently added an interesting feature to this sieve, for collecting and cleaning the foraminifera taken in the trawls, and of which many quarts were frequently washed away and lost by the old method at every haul. The canvas tube is simply arranged to lead into the side of a cask placed close to the sieve, and from which the water escapes at a slightly higher level on the opposite side. The heavier particles carried through the tube by the great force of the current are thereby given a chance to settle in the cask; the lighter sediment, composed mostly of fine mud, passing off through the outlet. After the washing has been accomplished, the water remaining in the barrel is decanted or drawn off through a siphon. The washing, in both the cradle and table sieves, is accomplished by means of a stream of water supplied through a hose. The large sieve figured on the deck of the French steamer Talisman in a recent number of *La nature* (see *Science*, vol. iii. p. 453) appears to partake of the character of the table sieve above described, although its details are not shown.

RICHARD RATHBUN.

KAFIRISTAN.

THE adventurous journey of Macnair, disguised as a native physician, into Kafiristan has given us the first testimony of a European eye-witness to the characteristics of that country and its inhabitants. Without recounting the itinerary, or specially detailing the perils of the traveller, which were not few, it may be mentioned that a part of his route lying between Mirga and Lowerai Kotal was at an altitude of 10,450 feet above the sea-level, winding through the snow between heaps of stones, which cover the remains of Mohammedans assassinated by the Kafirs. Elphinstone relates, in his 'History of Kabul,' that, on the occasion of a sacrifice, the prayer offered was, "Defend us from fever, increase our wealth, kill the Mussulmans, and after our death admit us to Paradise." It appears that none of their religious duties are better attended to by the Kafirs than that of killing the Mussulmans. Much the same importance is attached to it as belonged to head-hunting among the Dyaks, and no young Kafir is allowed to marry until he has killed at least one. A very similar feeling would seem to exist towards Europeans.

Kafiristan embraces an area of some five thousand square miles, limited to the north by the stupendous crest of the Hindu Kush, of which at least one peak rises above twenty-five thousand feet; on the south by the Kunar range; and on the east and west chiefly by the Alishang and Kunar rivers. Three distinct tribes — the Ramgals, Vaigals, and Bashgals — correspond to and occupy the three principal valleys of the country, the last being subdivided into five clans. The Vaigals are reputed to be the most numerous, and occupy the largest valley. Each tribe has a distinct dialect, but all have many words in common. In general, the three tribes have few relations with each other. Altogether, they are supposed to number about two hundred thousand people.

The country is wild, picturesque, and densely wooded. The men are fine-looking. Blue eyes are rare, but brown ones, and light, or even reddish hair, are common. The complexion varies from a ruddy blond to a bronze color, which is, doubtless, partly due to exposure. Their stature is but moderate. The men are fearless but lazy, and leave the work of agriculture to the women. When not at war they hunt. They are devoted to the dance, with which they occupy most of their evenings. The dance in use is invariably initiated by a woman, who goes through a prelude of graceful posturing. At a given signal, the dancers take their places on either side of the fire; the musicians, with a drum, flutes, and cymbals, taking a place at the end of the lines. At a second signal, couples form, and later turn singly around the fire. The dance terminates by a new formation of couples, holding a stick between them, feet firmly planted and close together, when they turn with great rapidity, first from right to left, and then in the reverse direction.

The houses are constructed on the mountain-side. The ground-floor is of stone, ten or twelve feet high, and is not used, except for storing wood and dry dung, both used for fuel, the latter especially in the preparation of cheese, which is made daily, and is of good quality. Above the stone foundation the structure is entirely of wood, with a sort of gallery around it. There are but two rooms, clean but very dark. The door-jambs are rudely carved. There is little furniture, but chairs of wood or wicker are in general use. The ordinary food is composed of bread and cheese in a sort of sandwich, dipped in melted butter, and boiled meat. The beds are built like a bunk attached to the wall. Some houses are provided with two stories, both of similar construction. The roof is made of flat stones, covered with a coating of clay.

The temples comprise a single square room, in which there are some large water-worn stones taken from the bed of the river, but no idols, except certain figures used in the funeral ceremonies be so considered. The dead are taken in their coffins into the temple, where sacrifices are made, and the remains then carried to the appointed place in the cemetery, but they are not buried. As to religion, the Kafiri believe in a passive supreme being, and a very active devil to whom all mischances are ascribed.

The men shave the head, except a single long lock on the summit, and go uncovered. Their dress is much like that of the Afghans, chiefly of cotton, with leather buskins made of laced strips of hide. The women wear the hair long, coiled under a large bonnet, through the top of which two tufts of hair project, looking at a distance like horns. Slavery is practised. Polygamy is exceptional. The unfaithful wife is beaten, and her lover fined not less than six head of cattle, and more according to his means. They have been supposed to be great wine-bibbers; but Mr. Macnair found in use only grape-juice, neither fermented nor distilled. This is pressed out during the vintage, and kept in jars under ground until needed. They are armed with the bow and arrow and a few matchlocks. The traveller observed artificial ponds, made to entice the wild ducks who pass over in their annual migrations. Some of the rivers carry gold; but the chiefs oppose washing for it, having in view the inevitable consequences to which successful gold-mining would give rise.

The people are intensely jealous of European invasion. The mere suspicion of European origin several times put the life of Mr. Macnair in serious danger, and intended journeying in several directions was given up as unsafe on this account.

THE CHANGES WHICH FERMENTATION PRODUCES IN MILK.[1]

MILK, if left standing a short time, becomes a sort of acidulated jelly called curd. In cheese-making this transformation is hastened by bruising; but in both cases the acidity and the peculiar savor of the curdled milk are caused by a microbe, the lactic bacillus, whose little rods are swimming by millions in the turning liquid. Only the caseine, the albuminous portion of milk, which forms the principal ingredient of cheese, coagulates: the lactic bacillus, recently studied by Mr. Hueppe, avoids this, and prefers the sugar of the milk, which it changes into a lactic acid. Without the bacillus, the milk would not sour. If milk, when fresh, is carefully poured into sterilized flasks, and corked, it may be preserved indefinitely. Repeated warmings have the same effect; but the operation is too delicate to be of practical value. If we touch curdled milk with the point of a pin, and then plunge the point into fresh milk, in a few hours this milk will also be curdled. This pin-point carries the lactic bacilli in sufficient quantities to sow any quantity whatever of the milk-food. By introducing other microbes, milk will undergo a number of dissimilar transformations, according to the germs which are sown in it. The germs of the butyric bacillus condense the milk without its becoming acidulated: on the contrary, it will have an alkaline reaction, with a bitter taste, and an odor resembling that of fresh cheese or whey. By adding a little blue milk, in a few hours the whole becomes blue. The milk neither curdles nor sours, but a drop examined under the microscope is seen to swarm with vibrios. This is the cyanogen bacillus; and when sown in glue, in potato, or in soup, it everywhere multiplies, and makes the substance blue. At times this bacillus causes an eruption, which is cured with much difficulty. Milk is not rendered unwholesome by it, nor disagreeable in taste; but it is blue, which does not increase its market-value. A little ropy milk added will in three days make milk so thick that we can invert a bottle containing it without losing a single drop. In this case a peculiar microbe, a micrococcus, has been at work. This has been described by Mr. Schmidt-Mulheim, who deserves a place of honor among confectioners; for he has discovered a method of producing

[1] Abridged from an article by Dr. H. FOL, in the *Journal de Genève*.

a substance much resembling gum tragacanth, which, when added to the jelly, makes it harden. This milk-jelly is easily digested, its taste is perfect, and it may be preserved, even in the air, for ten days. The inhabitants of the north of Sweden preserve the precious microbe, caring for it as the savages care for their fire. They put it in all the milk they wish to preserve, as such milk is better and more easily obtained, in every case, than the condensed milk of the factories of Cham and Montreux. Alcoholic fermentation is produced in milk when sown with koumiss, or with the fungus of kéfir, a favorite Russian drink. This curious ferment is a combination of two distinct ferments, — a yeast analogous to that of wine, and a microbe, Dispora caucasia. These two organisms live together in perfect harmony, and for a common end,— the production of a gaseous, piquant, agreeable, and, above all, healthful beverage. The kéfir is especially valuable as a food for infants and invalids. Several physicians of Geneva intend to make trials of it, and we are in hope of being soon enriched by the addition of a new and valuable hygienic food.

THE MERIDIAN CONFERENCE.[1]

AT Tuesday's meeting, Oct. 14, the resolution to reckon longitudes east and west from Greenwich to plus and minus 180° was advocated by Professor Adams, Capt. Evans, and Gen. Strachey, of Great Britain, and by Mr. Rutherford; the very strong point being urged in its favor, that the jump in longitude from + 180° to − 180° occurs in the Pacific Ocean, where the local time now jumps twenty-four hours, — and it must do this somewhere, — and hence it will cause no change from the present practice among navigators, or in the date of the present local time of any part of the earth; and the relation between the local date and hour of any place, and the universal time of the Greenwich meridian, will always be correctly given by the simple formula, $L.T. = U.T. + \lambda$, λ being the longitude expressed as above. After a short recess for informal discussion, the resolution was adopted by a small majority.

A resolution was then introduced, that the conference propose the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local time where desirable.

The delegate from Italy offered as a substitute the resolution of the geodetic conference at Rome, which proposed a universal day of twenty-four hours, beginning at Greenwich, mean noon; i.e., the present astronomical day, twelve hours later than the civil.

Mr. Allen here read a paper upon the needs and conveniences of the railroads and telegraphs, advocating local times differing whole hours from each other, and introduced a resolution that local time be held to mean that of the nearest meridian situated some whole number of hours from Greenwich; but, after some discussion as to the competence of the conference to go so far into details, he withdrew it.

The resolution to adopt the recommendation of the Roman conference was lost, and the original resolution was adopted by a large majority.

It was then proposed that the universal day be a mean solar day, to begin for all the world at the moment of midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian, and to be counted from zero up to twenty-four hours.

To give time for informally considering this, and for the secretaries to revise and publish in English and French the two-days' proceedings, the conference adjourned till Monday, the 20th.

At the meeting on Monday, the delegate from Spain proposed the adoption of a universal day corresponding to the local day of Rome, 'on account of classic historical associations,' and apparently with the idea that somehow the epoch of the Gregorian calendar would be changed by adopting the Greenwich day.

Professor Adams and Commander Sampson pointed out the confusion that would arise from reckoning time from one meridian, and longitude from another; and, after further discussion, all the amendments were voted down, and the original resolution, recommending a universal day beginning at midnight of the prime meridian, and counted from zero to twenty-four hours, was adopted by a considerable majority. Another resolution was passed by a large majority, expressing the hope of the conference that the astronomical and nautical days may soon be arranged everywhere to begin at midnight.

Mr. Janssen introduced a resolution expressing the hope of the conference that all nations will make a study of the advantages of dividing the day and circular measure, wherever used, into four quadrants, with decimal division of quadrant. After considerable discussion, this was adopted with a slight modification in the phraseology.

Gen. Strachey offered a resolution recommending that all local times differ, by some multiple of ten minutes, from that of the prime meridian. Without acting on this, the conference adjourned till Wednesday.

[1] Continued from p. 378.

COTTERILL'S APPLIED MECHANICS.

Applied mechanics: an elementary general introduction to the theory of structures and machines. By JAMES H. COTTERILL. London, *Macmillan*, 1884. 20 + 584 p. 8°.

THE appearance of a new book by the distinguished lecturer on applied mechanics at the Royal naval college, the organization of which he has done so much to forward, and the prosperity and success of which are ascribed so largely to Professor Cotterill, is an event likely to interest all who are engaged in similar lines of work. The opportunity is not open to the writer upon the subject of applied mechanics to produce as completely novel a work as was the earlier book by the same author, — 'The steam-engine considered as a heat-engine.'

The work is professedly based upon Rankine's treatise, and is supplemented by a large amount of other, and some new, matter. The plan of the work is in some respects unusual. Its first part is devoted to the statics of structures, the second to the kinematics of machines, the third to the dynamics of machines, the fourth to the strength and stiffness of materials, and the fifth to the transmission and conversion of energy by machines.

In part i. but little will be found to demand special notice. The methods of graphical statics are adopted throughout, and are applied in succession to the simplest and the more complex cases. The straining action of a load applied to a structure is considered in several chapters; shearing, bending, and twisting being taken up in order. Cases of frames having redundant parts, and the action of a travelling load, are given with propriety considerable space. In part ii. we find the author following Rankine in an innovation upon the standard plan of text-books on mechanics as hitherto constructed. Professor Cotterill here introduces the study of the kinematics of machines, — a subject not often considered to form a part of this general division of the theory of engineering, and only treated of, up to the present time, to any considerable extent, in separate works, as in Willis's and in Reuleaux's well-known works. Rankine introduced this subject, under the title 'Geometry of mechanism,' into his 'Machinery and mill-work,' and introduced it also in his 'Applied mechanics.' This author has introduced to a limited extent the nomenclature and methods of the latest of the great masters of this division of the science of engineering, Professor Reuleaux, and has thus brought the matter fully up to the time. A feature of the work to be noticed here, perhaps even more than elsewhere, is the selection of mechanism familiar to the engineer, and where possible of those in common use, in illustration of the principles to be explained. Part iii., on the dynamics of machinery, as would naturally be expected, occupies a large amount of space. It opens with a statement of the 'principle of work,' shows how resistances are determined in common cases, defines energy, illustrates the methods of its transfer in machines, and considers the kinetic form of energy as met with in freely-moving bodies and in machines. A chapter is devoted to the dynamics of the steam-engine, and especially to the graphical representation of the variation of effort and of energy at the crank. All of this work is interesting and valuable; and the greater part of it is here for the first time, so far as the writer is aware, introduced into the literature of the schools.

The study of cases of incomplete constraint and of straining actions in machines gives the author an opportunity to introduce the principle of momentum and other dynamical principles, and to illustrate their application by the analysis of the governors and other familiar cases. Part iv., on the strength of materials, occupies more space than any other division of the book. Impact, compound stresses, and flow are as fully treated as the limits of the book permit, and more so than is usual in treatises of this character. The work of Professor James Thomson on the flow of solids is described, and the experiments of Tresca and of Wohler are cited.

The volume includes in its last division, part v., a discussion of the principles involved in the transmission of energy by fluids, and of its transformation. The flow of fluids, the action of machines driven by them, and the elementary principles of thermodynamics, are here studied.

An excellent feature of the book is its references to works in which the subjects treated are more fully developed by accepted authorities. Examples are introduced at the end of each chapter which are doubly interesting as illustrating the special case there treated, and as exhibiting applications occurring in the engineer's practice. The engravings are numerous, and, in all cases in which it is possible, drawn from working machines and structures common in engineering.

The work as a whole is one which will not only increase the reputation of its author, but will earn for him the thanks of many instructors in technical schools who have long been hoping for such a treatise as will permit them to discard works, which, valuable in their day, are now left behind in the forward movement of the profession of engineering and of science.

SCIENTIFIC BUTTER-MAKING.

A manual for scientific butter-making. By W. H. Lynch. Printed by order of the legislative assembly. Toronto, *Robinson pr.*, 1883. 15+204 p. 8°.

The author, in the introduction to this manual, expresses himself in sympathy with the views advanced by Arnold and Bell on previous occasions, that all persons connected with the prosecution of the dairy business should strive to make themselves familiar with the principles on which success depends. These

MAN'S FUTURE.

The destiny of man, viewed in the light of his origin. By JOHN FISKE. Boston, *Houghton, Mifflin, &* 1884. 16°.

THE question of a future life is generally regarded as lying outside the range of scientific inquiry, says the writer; but yet he thinks it is one upon which an opinion may be legitimately entertained, and he proceeds to ... must necessarily be affected ... the mass of our opinions on the questions which ... lie within the scope of scientific inquiry. His essay is to let us know what the teachings of the doctrine of evolution ... the origin of man seem to indicate as to ... destiny. His conclusion is, that "the ... we comprehend that process of evolution by which things have come to be what they are, the more we are likely to feel that to deny the everlasting persistence of the spiritual element in man is to rob the whole process of its meaning," and that it goes far toward putting us to permanent intellectual confusion ... which, as a well-known authority assures us, is a scientific *reductio ad absurdum.* ... sufficient reason for our accepting ... alternative," our author declares. "For my own part, therefore, I believe in the immortality of the soul, not in the sense in which I accept the demonstrable truths of science, but as a supreme act of faith in the reasonableness of God's work. . . . The belief ... most quickly defined by its negation, ... to believe that this world is all." ... must refer to the little book itself for the ... argument which leads up to this *credo.* ... the argument, however scientifically ... philosophical and even theological ... needs only to be understood that this essay is, in fact, an address to the Concord school of philosophy last summer, at the time when the subject of immortality was under discussion.

NOTES AND NEWS.

THE following is the full list of papers read at the Newport meeting of the National academy of sciences, Oct. 14–17: On the Columella auris of the Pelycosauria, E. D. Cope; The brain of Asellus, and the eyeless form of Cecidotaea, A. S. Packard; On the theory of atomic volumes, Wolcott Gibbs; On the complex inorganic acids, Wolcott Gibbs; Notice of Muybridge's experiments on the motions of animals by instantaneous photography, Fairman Rogers; Notice of Grant's difference-engine, Fairman Rogers; On the thinolite of Lake Lahontan, E. S. Dana; On the mesozoic coals of the north-west, R. Pumpelly;

On the work of the Northern transcontinental survey, R. Pumpelly; The grasses mechanically injurious to live-stock, William H. Brewer; On gravitation survey, C. S. Peirce; On minimum differences of sensibility, C. S. Peirce and (by invitation) J. Jastrow; Researches on Ptolemy's star-catalogue, C. H. F. Peters; On the operations of the U. S. geological survey, J. W. Powell; The motion of Hyperion, Asaph Hall; Remarks on the civilization of the native peoples of America (by invitation), E. B. Tylor; Some results of the exploration of the deep sea beneath the Gulf Stream, by the U. S. fish-commission steamer Albatross during the past summer, A. E. Verrill; Recent progress in explosives, H. L. Abbot; On an experimental composite photograph of the members of the academy, R. Pumpelly; Report on meridian-work at Carlsruhe (by invitation), W. Valentiner; On the algebra of logic, C. S. Peirce; On the temperature of the lunar surface, S. P. Langley; On methods of eastern archery, E. S. Morse.

— A letter to Lieut. Schwatka, from one of the officers of the Imperial geographical society of Russia, states that no polar expedition is to start from Russia this year or next, as has been widely circulated in the American press. There is in view, however, an expedition to the New-Siberian Islands, to start in the spring of 1886, to be carried on by money appropriated by the czar for that purpose. The expedition is to be undertaken by two gentlemen from the Imperial academy of sciences of St. Petersburg, and the preparations for it are going on under the supervision of a committee appointed by the academy. The year 1885 will be employed in scientific work on the Yana and the coast between it and Indigirka.

— Among recent deaths we note those of G. B. Delponte, formerly professor of botany in the university of Turin, well known for his researches upon the Desmidiae, on the 18th of May, at Mombaruzzo, Piedmont; Count Constantin Branicki, a zealous promoter of natural science, to whose generosity the museum at Warsaw is indebted for a large part of its valuable collections, July 14, at Paris; August Pasch, professor of mathematics at Stockholm, in that city, on the 16th of July; L. M. Larsson, author of 'Flora af Wermland,' on the 17th of July, at Carlstad, Sweden; Dr. M. Perty, a well-known zoölogist and anthropologist, from 1834 to 1875 professor of natural history in Berne, where he died Aug. 8, almost eighty years of age; in Moscow, the last of July, A. G. Fischer von Waldheim, president of the Moscow natural-history society; E. P. M. Fournier, botanist, in Paris; Lodovico Caldesi, botanist, July 2, in Faenza; Dr. E. Carstanjen, chemist, on the 13th of July, at Leipzig, in his forty-ninth year; Dr. Hans Hübner, the director of the chemical laboratory at Göttingen, on the 13th of July, in his forty-seventh year; and Dr. Ferd. Hochstetter, geologist and naturalist on the Novara expedition, on the 18th of July, in his fifty-sixth year.

— Prof. F. E. Nipher finds from data taken from Dr. Engelmann's observations at St. Louis, Mo., lasting over a period of forty-seven years, that the duration of maximum rains is inversely proportional to the violence, or that the product of violence into duration is constant. This constant is the amount of water which may fall in a continuous rain, and is, for Dr. Engelmann's series of about half a century, about five inches. A rain of five inches per hour may last one hour. A rain of four inches per hour may last an hour and a quarter; and such a rain Dr. Engelmann observed. A rain of two and a half inches per hour may last two hours, and several such rains were observed. A rain of an inch per hour may last five hours. Each of these cases would be a five-inch rain. For a longer period of time than fifty years it is likely that greater rains than five inches may be observed. The same is to be said if observations are to be taken over a wider area of country. In fact, a rain of six inches in three hours occurred near Cuba, Mo., some years since. This would increase the value of the constant from five to six, but otherwise the relation will probably remain unchanged.

The importance of this law is very great in engineering, where the capacity of sewers, culverts, and bridges, must be such as to carry the water. A more general investigation which Professor Nipher is now making will determine the relation between the violence, duration, and frequency not only of maximum, but of all rains. This work, when completed, will enable an engineer to construct the water-ways of bridges of such a capacity that they will probably stand a definite number of years before they are washed away. This number of years will be so determined that the interest on the invested capital during the probable life of the bridge will equal the possible damage when the destructive flood comes which the engineer determines shall destroy his work. The running expense of maintaining the bridge is then the least possible.

— A late number of the *Academy* states that the eleventh annual meeting of the German and Austrian alpenverein has just been held at Constanz, under the presidency of Herr Richter of Salzburg. The grand duke of Baden took part in the proceedings. The united clubs have a membership of 12,500, and the property of the verein amounts to 11,430 florins. Grants were voted for forest-planting, for support of certain mountain sections of the club, for payment of persons who have engaged to lecture during the winter months, for meteorological observations, and for explorations of caverns. Next January will be published the first collected volume of the *Mittheilungen* of the club, with illustrations. Collections of 3,130 marks and 9,925 florins were made for paths and huts. Villach was selected for next year's meeting.

— Signal-service note xvi., entitled 'The effect of wind-currents on rainfall,' by G. E. Curtis, is one of the most carefully prepared numbers of the series, both in the reference to previous work on the subject, in which English, French, and German authors are quoted, and in the discussion of the special series of records from five gauges on the summit of Mount Washington. The author concludes that the rainfall (without snow) in such exposed situations varies materially within distances of only one or two hundred

feet; that the windward gauges receive least and the leeward gauges most rain, as had been stated for buildings by Bache in 1837; and that, in high winds, small gauges do not collect enough rain, the discrepancy between eight-inch and three-inch gauges varying as the square of the wind's velocity; and, for velocities of sixty miles an hour, the three-inch receiving only two-thirds of the rain collected by the eight-inch gauge.

— The elasticity in the carbon filaments of the incandescent lamps, at least in some of the patterns, is rather remarkable. Take an Edison lamp of about a hundred ohms resistance, and a moderately sharp blow with the hand at right-angles to the plane of the loop will vibrate it so far that it strikes the side of the glass bulb; and it will continue for two minutes, swiftly vibrating through very slowly decreasing amplitudes, and with beautifully complicated nodal effects, according to the direction of the blow. So sensitively elastic are some of them, that it is difficult to hold them in the hand so steadily that the upper part of the loop is not blurred by rapid incessant vibrations of small amplitude.

— The Royal society of New South Wales offers its medal and a money-prize for the best communication (provided it be of sufficient merit) containing the results of original research or observation, upon each of the following subjects. To be sent in not later than May 1, 1885: anatomy and life-history of the Echidna and Platypus, the society's medal and £25; anatomy and life-history of Mollusca peculiar to Australia, the society's medal and £25; the chemical composition of the products from the so-called kerosene shale of New South Wales, the society's medal and £25. To be sent in not later than May 1, 1886: on the chemistry of the Australian gums and resins, the society's medal and £25.

— The committee of the Octagon chapel at Bath, England, where Sir William Herschel was organist from 1766 to 1782, invites subscriptions toward a memorial-window of one whom they truly call ' by far the most distinguished citizen who ever lived in Bath.'

— The *Illustrirte zeitung* reports that the new torpedo-boat tried at the recent manœuvres of the German fleet has proved eminently satisfactory. In addition to its great strength and speed, it has water compartments which can be suddenly filled, and thus sink its deck to the level of the sea, without seriously impairing the speed of the vessel.

— The London health exhibition has been so successful, that it is expected the council will have a handsome balance when they close their doors; and they have not yet decided what to do with it. The aggregate of admissions now exceeds two millions and a half, representing a gross taking of a hundred and ten thousand pounds, ten per cent of which may remain when the last liability has been wiped off.

— Mr. Farini of the Royal aquarium, London, has now on view some of the dwarf race of men reported by several travellers as dwellers in equatorial Africa; and he has invited all anthropologists there to study this strange development of the human race. The tallest of them is four feet six inches in height, and professes to be a giant among his own people. They are exceedingly intelligent.

— The Social science congress this year met at the place of its origin, Birmingham, and attracted a much larger attendance than last year, the programme of work being a fine one. The president of the year, Mr. Shaw Lefevre, in his opening address, reviewed the reaction from the non-intervention views of state policy of Ricardo, Stuart Mill, Bastiat, etc., and stated his opinion that the present "movement for extending the action of the state has not been due only to democracy. It has been demanded almost equally by all classes; but the greater force of the popular will in parliament has deprived the opposing interest of their power of resistance. . . . The more recent school of political-economists in this country, and still more on the continent, has largely departed from these (earlier) views, and has held, that while free exchange, free labor, and free contract are important principles to maintain, yet the state is bound to interfere when individual interests result in the degradation and oppression of the lower classes, and that it is justified in undertaking those works and functions which can be better attained by it than by individual effort. Almost alone, my friend Mr. Herbert Spencer has been left among philosophers, to preach the doctrine of *laissez faire*, to raise the banner of individualism against state action, and to denounce what has been done during the last few years as radically wrong in principle, and leading to socialism, or to the ultimate slavery of the masses."

During the last ten years, he stated, taking the increase of population of England and Wales into account, there had been a decrease of pauperism of thirty per cent, and of serious crime of twenty-two per cent.

— Prof. W. Braune claims to have discovered some constant principles of arrangement of the veins in the human body, the variability of which has been an anatomical puzzle of long standing. He proposes to publish an atlas in imperial folio under the title '*Das venensystem des menschlichen körpers*.' The first part with four colored plates, prepared with the collaboration of Mr. E. Harry Fenwick, is now announced by Veit & Co. of Leipzig; price 45 Rmk.

— The Prussian authorities are planning a hygienic institute, as a branch of the University of Berlin, similar to the existing institutes of physiology, etc., this branch of knowledge being recognized as necessary to the medical profession. It is said that Dr. Koch will be placed at the head of it.

— Dr. Th. Liebisch, formerly professor of mineralogy at Greifswald university, has been called to the Königsberg university. The professorship of physiology at Königsberg has been given to Prof. L. Hermann (Zurich). Dr. L. Königsberger, formerly in Vienna, has been called to the professorship of mathematics at the university of Heidelberg. Dr. P. Dubois-Reymond of Tübingen has accepted a call to the Technical school in Berlin.

SCIENCE.

'RIDAY, OCTOBER 31, 1884.

)MMENT AND CRITICISM.

is probably nothing which we can as so entirely characteristic of our :h of history as co-operation, — the a number of men for a common pur- -operation is very old; but its present , and often also its form, are new, fore it has a significance for us, the which is great, but still unmeasured. leed, the very essence of democracy. ave not to do with the general aspects reat subject: we wish only to refer ncreasing development in scientific and even of that development we direct attention only to the prevalent towards systematic and organized ion.

recent numbers we have had occasion the progress of several noteworthy undertakings which are strictly co- . We need only remind our readers ew standard time, the electrical and conferences, and the reports of the ting committees of the British associa- llustrations of the accomplished good ence owes to co-operation. Our expe- the benefits to be had through the f competent men, united in confer- mmittees, and congresses, to settle entific problem, is rapidly changing formerly a sporadic effort into a con- bit of the civilized world. The same has another manifestation in the still el custom of what we venture to desig- co-operative observation. A central a society or committee, receives and the data obtained by scattered ob- The earliest instances we recall of hod of centralized collation is of gical observations, in this country conducted for many years by the Smithsonian institution. Such, too, is the method adopted by the English society for psychical research, by the American ornithological union for tracing the migrations of birds, by Mr. Galton in his remarkable studies, by the English committee for the collective investigation of disease; and so on through a long list. Again, through the energy of the Harvard observatory, there is an extensive system of co-operation among astronomers, and the British association is endeavoring to systematize the work of the numerous local societies in Great Britain.

One naturally stops to ask, What is to be the future? Will the co-operative tendency, which is already so strong, go on increasing? We think the answer must be in the affirmative; because the more systematized scientific research becomes, just so much surer and steadier will discoveries ensue. At present individual tastes have far too large a share in deciding what is investigated, and hence follows the deplorable consequence that many an important subject is neglected because no one happens to be interested in it. Moreover, there is much work to be done which can be accomplished only by scattered observers who obey a pre-arranged system. May we not, therefore, reasonably expect a great deal for science in the future from systematized co-operation?

The medical journals are just now giving an interesting illustration of the ease with which the members of a busy profession may overlook their own past, and occupy themselves with experiments and investigations, only to find that the same results and disappointments had been reached and fully recorded long before. Not many months ago a French physician, at the suggestion of another from Copenhagen, tried etherization by the rectum, and in a report of

cases called attention to it as a 'new method' for the administration of this anaesthetic. His work made an impression in his own country and on this side of the ocean. Others took up the method; and the journals had much to say about the promise which this improvement held out of being very useful, not merely in some special operations, but also in general. Then came reports of unpleasant complications and unexpected effects more or less beyond the control of the operator.

While this experience was growing, and practical rules were slowly getting formulated, some of the older doctors, and some of the more 'literary fellers' of the craft, bethought themselves, and remembered that this 'new method' was, after all, nearly as old as ether anaesthesia itself. It seems that in 1847 Pirogoff recommended this application of ether-vapor, others having tried a similar use of the liquid alone or in a mixture with water. Pirogoff and the few others who gave the really new method a trial were not altogether satisfied, and seem to have abandoned it in a short time, except to meet a few very special conditions. Twenty-one years ago (1863) all this was fully described, and the dangers of such administration pointed out, by Perrin and Lallemand in their work on surgical anaesthesia; and as late as 1875 Claude Bernard mentioned it as an 'historically curious' method of considerable uncertainty and little practical value.

There would seem to be no easy way of avoiding such repetitions, unless, perhaps, to have some member on the editorial staff of every medical journal learn a few of the larger indexes by heart, and stand ready to nip all 'new' methods and schemes in the bud. In general, however, a certain amount of repetition, even in practical matters, is not always objectionable; and, in scientific research in competent hands, it is even less so. The corroboration which may thus be obtained has frequently considerable value. Then, too, it must not be forgotten, that a fresh investigator who takes up an old problem apparently solved, perhaps is likely to approach it from another point of view, and with different traditions and equipment from his predecessors. Thus it is possible, that what at first appears to be needless repetition may lead to important results. It is a common experience, too, that few sets of old observations are really complete or useful, save for the particular and limited objects which interested the investigator.

THE use of the word 'scientific' at the present time, illustrates how custom overrides etymology, giving sanction to an application of a word quite inconsistent with its derivation. 'Scientific' means, strictly, 'knowledge-making;' but it is employed to signify 'relating to, or in accordance with, science.' Last week we reviewed a work on 'scientific butter-making.' Now, if we could, by any process of manufacturing butter, produce science at the same time, every one would agree that it was an eminently practical and economical invention; but, alas! the true Anglo-Saxon defies etymology; and nobody will misunderstand the customary meaning of 'scientific' in adjectival association with butter-making, or when used to qualify much else which never makes knowledge. The word is a curious example of error becoming correct through usage. If we could only add the word 'sciential' to the language, usage might then conform to etymology in regard to 'scientific' by transferring half its duties to the new adjective.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Iroquois grammar.

THE lively letter of your esteemed correspondent, Mrs. E. A. Smith, is satisfactory in one respect; as it explains clearly her views on the subject discussed by her at the late Montreal meeting, and now more briefly in your columns. Her remarks lead to inferences for which she is probably unprepared, and which she will be inclined to regret and disown; for she doubtless, like all who know the French missionaries among the Iroquois, has a high opinion of their learning and worth. Yet her suggestions necessarily imply that these worthy men are sadly incompetent

ties as teachers and translators, or worse petent. We are, in effect, given to under- they have either mistaken or purposely ted the meaning of certain important which they must have heard and used con- many years, and on which, to a great extent, force of the language depend. If this is eir scriptural and other translations, and and other original works, in the Iroquois which conform strictly to this system of must be all wrong. Furthermore, it must red that the English missionaries among n Iroquois (the Mohawks) have, during ndred years, published several scripture translations in that language. These, de altogether independently of the French nd with a very different orthography, are e same system of grammar; and if Mrs. ght, these versions are, of course, errone- further, several scripture translations made by educated Indians among both and the western Iroquois. These follow rammatical method. That Indians, writ- dians, would use their language incor- supposition which Mrs. Smith herself will be inadmissible. This simple fact is ecisive of the question, and shows clearly issionaries are in the right.

respected correspondent has any doubt correctness of the statement now made, dily satisfy herself by reading and analyz- nslations referred to. She has assuredly o do injustice to any person; and she will e pleased to have her attention drawn to nd satisfactory test. In justice to Mrs. self, it should be remembered that the one of the most difficult of languages, re- rs of study to master it. That a beginner ly, however intelligent and zealous, should ally at fault about a point of grammar, is al and pardonable; but that learned mis- who have had forty years of practice in the who speak and write it as fluently as they wn, and some of whom are accomplished s, should be mistaken on such points, is redible.

hat it is 'hazardous' for one who is not amiliar with a foreign speech to undertake d its niceties to those who are adepts in it, is hint a friendly warning. Nothing, indeed, re ill-advised than such an attempt. When ished French writer rashly suggested that of the 'Frith of Forth' was probably a cor- the 'first of the fourth,' his readers were measure from this absurd suggestion the his knowledge of the English language, and d him much injustice. THE REPORTER.

Points on lightning-rods.

B. Porter's letter in relation to points on rods (*Science*, iv. p. 223) suggests the pro- calling attention to the fact, that, inasmuch wer of points' in neutralizing the electrical the cloud depends upon the convective of the opposite kind of electricity from the he rod, it is evident that it requires time d to effectually perform its true function ing the cloud, and thereby averting the stroke. If a highly charged cloud is iven towards the point of the rod, the latter ave time to neutralize the electricity of the the rod may receive the disruptive stroke of lightning: this seems to have been the case with Mr. Porter's rod. If the cloud had slowly approached the pointed conductor, it would have been silently neutralized, and the stroke averted. The significant point is, that convective neutralization is a gradual process, requiring *time* (see *Nature*, xxiii. p. 386). A familiar class-experiment will illustrate this point. If a charged Leyden-jar is held in one hand, while a sharp-pointed needle is held in the other hand, and the point of the needle is slowly brought towards the knob of the jar, no shock will be experienced when the point of the needle touches the knob: the charged jar is silently neutralized during the gradual approach of the point. On the contrary, if the point of the needle is rapidly brought towards the knob, a visible spark will pass to it, and a more or less severe shock will be experienced by the experimenter. JOHN LECONTE.

Berkeley, Cal., Oct. 7.

A wider use for scientific libraries.

Your remarks in *Science* (iv. 335–336) on a wider use for the libraries of scientific societies, give me occasion to mention at least two societies which make such use of their libraries. I think you would do a service by collating a list of such societies, and making a statement of their rules for the loan of books. A brief standing notice, or one occasionally inserted, would be of service to your readers. Certainly the societies not deriving a revenue from these loans should not be expected to advertise at their own expense.

The constitution of the American association for the advancement of science provides that all books and pamphlets received by the association shall be catalogued, and that members may be allowed to call for such books and pamphlets to be delivered to them at their own expense; but as yet the books are not available, as the catalogue has not been made. The Cambridge entomological club allows subscribers to *Psyche* the use of its library under certain restrictions, — a library containing about a thousand titles. On the other hand, the American entomological society provides that "no books presented to the society shall be loaned from the hall under any pretence or for any purpose whatsoever."

The publishers of the *Revue et magasin de zoologie*, at Paris, conducted for many years a circulating library amongst the subscribers to the magazine, and reported that they had never sustained the loss of a single volume. Will not other societies or periodicals copy these practices? B. PICKMAN MANN.

Washington, D.C., Oct. 21.

A possible danger to mariners.

During the whole of the night of Aug. 23, 1884, the lantern of the lighthouse at Cape San Antonio, the westernmost point of the Island of Cuba, was surrounded by a cloud of winged insects, almost entirely of a bright red hue, their presence causing the light to assume a decided red color. The wind was moderate and from the south-west; the sky was overcast. A few of these insects have been sent to this city by Francisco Bautista, the keeper of the light, and identified as Dysdercus sanguinarius Stål, the cotton-stainer. Though other insects have been observed to fly towards lights, this is the first time that this species has been so reported. It is to be hoped that such dangerous action will not prove chronic with this brilliant and beautiful hemipteron. L. S. F.

New York, Oct. 23.

THE WORK OF THE MERIDIAN CONFERENCE.

THOUGH entangled and loaded down with the cumbersome and roundabout methods of diplomacy, and unnecessarily surrounded with the secrecy of our State department, the Meridian conference has yet reached, in the main, very sensible conclusions; much the same, no doubt, as a body composed entirely of the leading representatives of the scientific and business interests involved would have reached in one-fourth the time, with much greater unanimity, and without stirring up the feelings and jealousies which the semi-political character of the body has engendered, and which will make its conclusions of much less weight, since a considerable percentage of the delegates will decline to recommend them to their respective governments. But with England, the United States, and the principal European powers, France excepted, in accord, the action of the rest will be of less importance, however desirable unanimity would have been.

It was almost a foregone conclusion, that Greenwich would be selected as the prime meridian, on account of the overwhelming scientific and commercial reasons in its favor; while the proposition for an entirely new neutral meridian, with its necessary confusion and needless expense, merely for sentimental reasons, was too absurd to deserve serious consideration.

The conclusion to reckon longitudes east and west to plus and minus 180° is, no doubt, all things considered, the best. Considered simply as a method of putting down longitudes on charts, the continuous reckoning from 0° to 360° is, without question, less liable to mistake, simpler, and mathematically more elegant. But longitude is inseparably connected with local time, and herein arises the following difficulty. So long as the sun shines, and the earth revolves on its axis, the mean solar day, with its alternating light and darkness, must be the great natural unit of time-reckoning. Moreover, for civil purposes the date must change during the hours of sleep; and hence the civil 'day' must begin in the night, and should, for convenience, begin within an hour at least of midnight. Therefore civil dates and hours must be approximately local ones; i.e., must differ with the continuous westward sweep of the sun, the eastern times being farther ahead. A necessary consequence is, that on some meridian of the globe, where the east meets the west, the local time must jump one day; so that the people living on the west side of this line, i.e., in the 'far east,' will be one day ahead of their neighbors on the east side; and there is no way of avoiding this inconvenient arrangement. There is thus an inseparable connection between universal or absolute time, local time, and longitude; and the connection will be most simply expressed, and most easily comprehended, if the longitudes jump 360° at the same point on the earth where the local time jumps twenty-four hours.

The recommendations of the conference, that the prime meridian be that of Greenwich, that the universal day be the civil day (beginning at midnight) of the prime meridian, and that longitudes be reckoned to plus and minus 180° east and west respectively from this meridian, accomplish their object with the least change from the existing status, the day and the longitudes changing in the Pacific at 180° from Greenwich.

For the few islands lying close to, or on both sides of, the 180th meridian, like the Feejees, which are bound to keep up intercourse with each other, it will be most convenient to have the same day; and this will fall in with the adopted plans, if the longitudes are all given with the same sign, and extended a little beyond 180°, to include the group.

The recommendation to count the universal day from zero to twenty-four hours might well have been extended to the local times as well, though not so essential in this case. Still, the more international intercourse and cable news bring out the differences between local times and their relation to absolute time, the more inadequate and unsatisfactory seems the clumsy A.M. and P.M. division of the day into two parts. Railroads can do something towards doing

away with this by publishing their time-tables to twenty-four hours. But the great obstacle lies in the dials of our watches and clocks; for until the hour-hands are made to revolve once in twenty-four hours, either on a separate dial, like most astronomical clocks, or with a separate twenty-four-hour division, and numbers on the main dial, people will naturally cling to the twelve-hour period. There is also the additional obstacle, that, if clocks are to strike to twenty-four, these large-numbered hours would seem interminably long; but the change in the striking arrangements would not be of so much importance.

It seems unfortunate that Mr. Allen's resolution for local times, differing by whole hours from the universal time, was not recommended; for this would seem to be by all odds the simplest way of connecting local and universal times. It is already in almost universal use in this country.

The sixth resolution of the conference, recommending that the nautical and astronomical days correspond with the civil, is open to discussion. The two naturally go together. And to the navigator it is of little moment: he would simply change his chronometer-reckoning twelve hours, buy a new ephemeris, which the astronomer would have computed for him, make the proper entry in the log, and go on as before. With the astronomer it is a more important matter. The ephemerides are issued, and the computations projected, so far ahead, that five years at least would elapse before the change could be made, even if agreed upon to-day. But with the astronomer there is the same reason for changing date at noon as for changing the civil date at midnight. While the rest of the world is sleeping, he is at work.

The seventh resolution of the conference, which would seem to be a rather poor translation of a French original, contains a suggestion as important as any thing it did. We believe that all systems of weighing, measuring, dividing, and reckoning any thing whatever, should be the same as the system of numeration in use; and, as long as this is so universally decimal, such should be the system for all these. No doubt, an octaval system of numeration, with its possible subdivision, 8, 4, 2, 1, would have been originally better; but there is no sufficient reason for a change now.

NORTH-ATLANTIC CURRENTS.

From time to time the great iron sea-buoys set to mark shoals, or to indicate entrances to channels, are forced from their moorings, and go adrift.

These buoys are of several types. The nun-buoys are pear-shaped; and the largest of them are twelve feet long, and eight feet across in the widest, and about two in the narrowest, part. The can-buoy is like the nun-buoy, except that it is wider at the top: both are

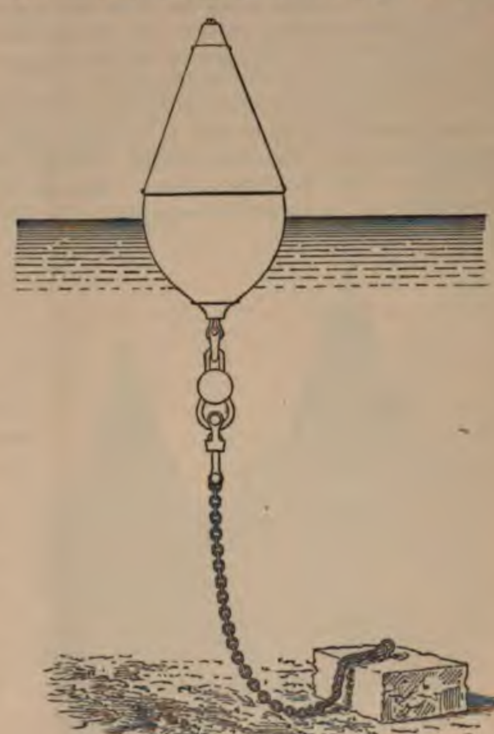


Fig. 1.—Iron nun-buoy.

widest at the line of flotation. In the oval bottom a steel loop is cast, to which is appended two fathoms of an inch-and-a-half stud chain, to which is fastened a solid iron ballast-ball of a thousand pounds weight, with two loops cast in it at opposite sides. To the ball is hung from fifteen to twenty fathoms of the

same-sized chain, to which is attached, in some cases, a three-thousand-pound mushroom anchor, which is shaped like an open inverted umbrella, and in many cases a stone-sinker, as shown in the cut. The buoy is separated by diaphragms into several water-tight compartments, so that one of them may be punctured without sinking the buoy. They are made of boiler-iron, and are tested by hydrostatic pressure before being placed in the water, and they will stand much hard usage.

When these buoys are lifted from their assigned positions by ice, they carry their moorings with them, and, when left by the ice, have sufficient buoyancy to float these accessories, though under such circumstances they are sunk somewhat below their ordinary line of flotation. They show a surface, at most, of eight by six feet above water, while the mushroom anchor it is dragging must be fully one hundred feet below water. Hence the winds can have little effect on the motion of the buoys, in comparison with the ocean-currents.

The whistling-buoy differs from the ordinary sea-buoy in having a hollow tube from eighteen to forty-five feet long thrust through it and down into the still water, while it is surmounted by a steamboat-whistle. As the

FIG. 2.—COURTENAY'S WHISTLING-BUOY.

buoy rises, the air is received into the tube through a set of ingeniously arranged valves. As it sinks, the air is forced out through the whistle.

The lighted or gas buoy is filled with compressed illuminating-gas, and is surmounted by a protected burner. It will burn from three to six months, according to its size, without being refilled.

As the government pays those who pick up any stray buoy a reasonable price for their trouble, they are often brought into port.

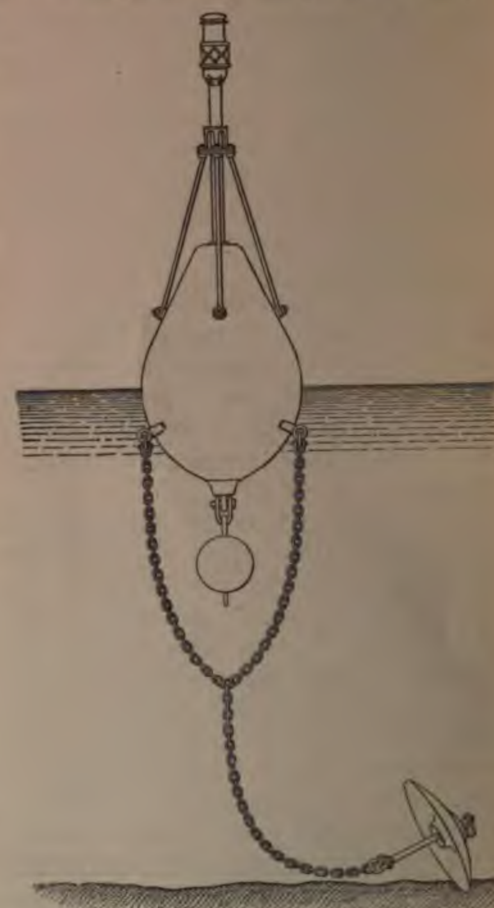


FIG. 3.—PINTSCH GAS-BUOY.

The position of each of the stray buoys so far reported, and the prevailing currents so far as known, are shown on the accompanying chart. The buoys are plotted and numbered to correspond to the paragraph below, which gives such history of the buoy as could be obtained from official sources. The buoys are not numbered consecutively, but in the order in which the writer heard of each being sighted.

1. Whistling-buoy, recently adrift, as the paint was still fresh when it was sighted, May 17, 1881.
2. Sighted June 15, 1884. Same as No. 19.
3. Can-buoy of the largest size, picked up March 17, 1881, near Bermuda; supposed to have come from New-York Bay.

4. Large iron sea-buoy, which had hanging to it about thirty feet of heavy chain. It came from Sandy-Hook bar, in New-York Bay.

5. One of the largest of the iron nun-buoys. There was hanging to it some twelve feet of stud-link two-and-a-quarter-inch chain, from which dangled a thousand-pound ballast-ball. It was picked up about the middle of July last, some twenty-five miles south-west from Montauk Point, in good condition except that its lower compartment was filled with water. It was evident that it had come from some part of our southern coast.

6. Large red buoy, with tower and lantern on top. It was discovered June 11, 1884, and would have been picked up but for the bad weather. Same as No. 7.

7. Picked up June 21, 1884, about four hundred and eighty miles due east of New York. Same as No. 6. This buoy went adrift from its station on Hatteras Shoal, off Cape Hatteras, between May 24 and June 4, 1884. It had made over twenty miles a day in a north-east course. It is of this buoy that *Science* said (No. 77, p. 92) that it was unfortunately picked up. If it had only been sighted and reported by each passing vessel, we might have had a record of its curious voyage, and known something more of the currents by which it was impelled.

8. Iron buoy of the largest size. It was picked up on the west coast of Ireland in the spring of 1871.

9. Iron nun-buoy of the largest size, with a heavy chain and ballast-ball attached. Went ashore in Pendeen Cove, Penzance Bay, on the south-west extremity of the English coast, about March 1, 1884. It probably left New-York Bay during the preceding winter.

10. Iron sea-buoy, picked up by the Norwegian bark Vance in March, 1871.

10½. Large nun-buoy painted red, passed July 20, 1884.

11. Iron sea-buoy, picked up on Aug. 30, 1883, on the eastern side of Teneriffe, with a thousand-pound ballast-ball and a forty-two-foot chain attached.

12. Second-class iron sea-buoy, was picked up on Oct. 20, 1883, about fifteen miles from the east side of Teneriffe, and had attached to it a fifteen-inch seven-hundred-and-fifty-pound ballast-ball, and about thirty feet of chain-cable.

13. Iron sea-buoy, picked up June 5, 1882.

14. Picked up Aug. 22, 1883. It was one of the largest iron buoys, and had attached to it a thousand-pound ballast-ball, forty-eight feet of heavy chain-cable, and a three-thousand-pound mushroom anchor. It was recognized as one of those carried to sea from New York Bay by the ice in December, 1880.

15. Iron sea-buoy, which went ashore in February, 1881, on one of the quays near Turk's Island; sent home.

16. Whistling-buoy, passed June 24, 1884.

Fig. 4.—Chart of stray buoys in the North Atlantic.

17. This is doubtless the same buoy as that numbered 18 and 22 on the chart. It was sighted June 29, 1884, and described as 'a large buoy, painted red, with patent fog-horn.'

18. A whistling-buoy. It stood about twelve feet out of water. It was passed June 29, 1884. The same buoy is plotted as No. 17, and also as No. 22, reported by two other ships.

19. Whistling-buoy, passed July 14, 1884. The same buoy is plotted as No. 2 on the map, and was seen a month before by another ship.

20. Second-class red whistling-buoy, picked up April 30, 1884, twenty-five miles off Cape Cod, which had broken adrift from Lurcher Shoal, Nova Scotia. This is the only case where a buoy is known to have drifted at once to the southward.

21. After the other buoys were plotted, it was found that No. 21 and No. 6 were the same buoy, it having been twice reported by the same ship: so it has only been plotted as No. 6.

22. Passed June 23, 1884; last position on the chart as No. 17 and 18 in the positions in which it was reported by two other vessels.

23. Iron can-buoy [illegible] by a British bark June 27, 1884, about [illegible] miles from the Flemish Cap, on the banks of Newfoundland.

24. Large iron buoy passed June 28, 1884, sixteen miles south-west from Gay Head, Martha's Vineyard.

25. Large iron nun-shaped buoy passed June 24, 1884, forty miles west of Bishop, Scilly Isles, off the west coast of England.

26. Black can-buoy passed June 29, 1884.

27. Large red iron buoy floating upright passed July 7, 1884, seven miles from Bishop Rock, Scilly Isles.

28. Very large red iron buoy, passed Aug. 4, 1884.

29. Large nun-shaped iron buoy, passed Aug. 1, 1884.

30. Large iron can-buoy which from appearances had been floating a very long time; passed Aug. 4, 1884.

31. Second-class can-buoy, picked up on the banks of Newfoundland, August, 1884.

32. Second-class can-buoy, picked up about twenty-five miles from Cape Elizabeth, Me., in August, 1884.

It would almost seem as if the buoys shown on this chart had attempted a system of circle-sailing, and as if several of them had nearly gotten round to their moorings after having circumnavigated the North-Atlantic Ocean. How else shall we account for the position of those picked up off the Canaries, those sighted in the Sargasso Sea, those found off Turk's Island and the Bermudas? When some of these data were presented to the Philosophical society at Washington, and the matter was discussed by naval, coast-survey, and light-house officers, the weight of the expressed opinion seemed to be in favor of this theory.

But the object of this paper is to call attention to the fact that the voyages of these buoys show the trend of surface or submarine currents, of which we as yet know little, either as to their direction, force, or times of flow. The current indications on this chart show the approximate sum of our present knowledge on the subject. It is evident that it would be greatly to our advantage to know more. *Science* said a short time ago that it was unfortunate that the gas-buoy (No. 6) was picked up. Would it not be in the interests of science, of commerce, and of navigation, if some such object as that buoy, drawing as much water, floating as lightly, showing as little surface to the wind, and offering as little resistance to colliding vessels, were allowed to float, and were carefully watched until it should have gone ashore? And why could not some slow-sailing vessel be detailed for such duty? At any rate, if such an object were set afloat and reported by every vessel which sighted it, its voyage might add much to what we know of the ocean-currents: and if such objects were set adrift simultaneously, from, say, Nantucket, Penzance, Teneriffe, the Cape de Verde and Turk's Island, or the Bermudas, we might learn much more on this interesting subject.

A. B. JOHNSON.

DRUMLINS.

THE arched hills of glacial drift that have been called drumlins by the Irish geologists are among the most peculiar results of the action of land ice-sheets. They are composed of closely-packed bowlder-clay, or till, distinctly unstratified, and containing well-scratched stones. They rest on a foundation of glaciated rock, and rise in a smoothly rounded mass from fifty to two or three hundred feet in height, reaching from a quarter of a mile to two miles in length. Their bases vary in form from a circle to a long, narrow oval; and, when elongated, their major axes are closely parallel to the direction of former local glacial motion. They are therefore easily distinguished in form and structure from the rolling hills of terminal moraines, and from the ridges and mounds of osar and kames. Although they form pronounced features in a landscape, their distribution is as yet

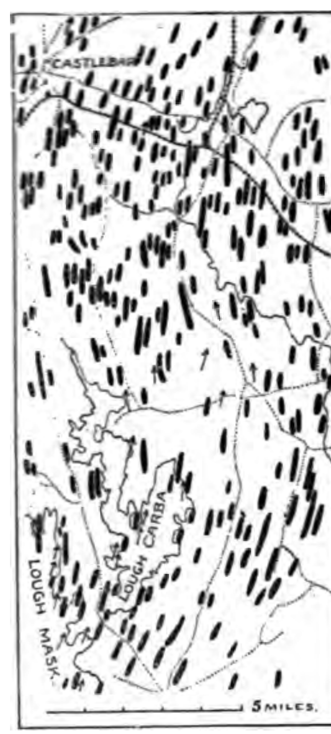


FIG. 1.

imperfectly understood. In continental Europe they have not attracted attention; but in Scotland and Ireland they are numerous and well known. Fig. 1 shows a remarkable group of them in northwestern Ireland, taken from a map prepared by Messrs. Kinahan and Close. In this country they have received careful study by Prof. C. H. Hitchcock and Mr. Warren Upham, of the New-Hampshire geological survey. Fig. 2 is copied from the southeastern corner of their map; and fig. 4 presents a sketch of a few of these hills near the Merrimack, in the neighborhood of Amesbury, Mass. Around Boston they are again well developed, as illustrated in fig. 3, from a manuscript map by the author. Fig. 5 is a view of Corey's Hill, a few miles from the city, in the town of Brookline; and fig. 6 represents some of the harbor islands, nearly all of which are drumlins, more or less cut away by the waves. A great series of these drift-hills stretches through central Massachusetts into Connecticut, but its limits have never been studied. Two of them at Charlton, on the Boston and Albany railroad, are drawn in fig. 7. Again in New-York, between Syracuse and Rochester, elongated drift-hills, that probably deserve the name of drumlins, may be seen in great numbers: here they have entire control of the topography, and

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

produce a most characteristic landscape. Fig. 8 gives the view south-east and south-west from one of the hills at the town of Clyde, on the New-York central railroad; and fig. 9 illustrates some of their common varieties of form. Farther west they are described only in Wisconsin, where they are sometimes circular and symmetrical, as in fig. 10, from Professor Chamberlin's geological report.

FIG. 6.

FIG. 7.

FIG. 8.

FIG. 9.

FIG. 10.

From this brief survey, it may be seen that drumlins have both a wide and an irregular distribution, and, further, that much more observation and mapping are required before we shall acquire a satisfactory explanation of their seemingly accidental occurrence.

As to origin, there is a general agreement now, among the observers who have studied them, that their present form is an immediate result of ice-action; but just how they were constructed is still an open question. The theory that seems most satisfactory is that which compares them to sand-banks in rivers, and thus considers them the result of gradual local accumulation of drift beneath the old glacial sheet, where more material was brought than could be carried away. The author will be pleased to learn of other localities for drumlins than those here mentioned.

W. M. DAVIS.

Cambridge, Mass.

HOW FAR A LIGHT MAY BE SEEN UNDER WATER.

MR. EDOUARD SARASIN recently made an interesting report of the experiments of the committee of the physical society of Geneva, in regard to the transparency of the water of the lake. The auxiliary society of Geneva generously gave the committee twenty-five hundred francs to aid in the researches; and Messrs. Soret, Sarasin, C. de Candolle, H. Fol, A. Rilliet, Ch. Soret, Plantamour, and R. Pictet took part. Three candles in a lantern (the flame being fed by a continuous current of air) are visible, at a depth of thirty metres, in the pure water of the lake. An electric light was distinctly seen in the water at the foot of the hydraulic machine of Geneva at a depth of thirty-three metres. A few centimetres more caused the clear image to disappear, which was replaced by diffuse light, faintly perceptible at sixty-seven metres. Messrs. Sarasin and Soret noticed a very characteristic absorption ray in the spectrum of light which had traversed a certain layer of water. This ray had been seen before, but former publications had not attracted the attention of physicists. The recent observations confirmed the fact, and completed the data already obtained. This ray is in the red, near *B*. The same physicists have also undertaken experiments upon the transparency of water when agitated with insoluble substances, such as the chloride of silver, etc. They find that the distance of clear vision varies very little with the increase of the brilliancy of the luminous body and its absolute dimensions. Assisted by Dr. Marcet, the committee has made photographic experiments in the deep portions of the lake. Down to two hundred and fifty metres they find the effect of light on the sensitive plates; but this depth seems to be, at least for the plates now in use, the extreme limit of action of the sun's light. Below this point the lake is a vast, dark chamber.

THE MERIDIAN CONFERENCE.[1]

AT the meeting on Wednesday, the 22d, the work of the conference was finished so far as the transaction of new business is concerned. Gen. Strachey withdrew his resolution for ten-minute meridians for local time, and the conference then proceeded to pass a resolution reciting and affirming its action upon the seven resolutions already adopted. These, as finally determined upon, are as follows: —

1. "That it is the opinion of this congress that it is desirable to adopt a single prime meridian for all nations, in place of the multiplicity of initial meridians which now exist."

2. "That the conference proposes to the governments here represented the adoption of the meridian passing through the centre of the transit instrument at the observatory of Greenwich, as the initial meridian for longitude."

3. "That from this meridian, longitude shall be counted in two directions up to 180°, east longitude being plus, and west longitude minus."

4. "That the conference proposes the adoption of a universal day for all purposes for which it may be found convenient, and which shall not interfere with the use of local or other standard time, where desirable."

5. "That this universal day is to be a mean solar day; is to begin for all the world at the moment of mean midnight of the initial meridian, coinciding with the beginning of the civil day and date of that meridian; and is to be counted from zero up to twenty-four hours."

6. "That the conference expresses the hope, that, as soon as may be practicable, the astronomical and nautical days will be arranged everywhere to begin at mean midnight."

7. "That the conference expresses the hope that the technical studies intended to regulate and extend the application of the decimal system to angular measure, and to that of time, shall be resumed, so as to permit the extension of this application to all cases where it presents real advantage."

A final resolution was then passed, reading as follows: —

"That a copy of the resolutions passed by this conference shall be communicated to the government of the United States, at whose instance, and within whose territory, the conference has been convened."

With a hearty vote of thanks to the government for the facilities offered, to the president, Admiral Rodgers, for his impartiality and courtesy, and to the secretaries for their faithful work, and with a suitable response by the president, the conference adjourned, subject to the call of the latter, for the purpose only of verifying the protocols of the proceedings.

The phraseology of the seventh resolution is somewhat peculiar; and the word 'resumed' looks very much like a mistake in translating 'résumer,' as the resolution was introduced by the French delegates.

[1] Concluded from p. 406.

THE RESOURCES OF THE UNITED STATES.

THE seventh quarto volume of the Tenth census, containing the tables of valuation, taxation, and public indebtedness, must be regarded as the most exact, and one of the most valuable, yet issued. It is largely historical in its treatment of the subject, which allows an exact historical statement more readily than most of the subjects of these volumes; and it thus presents a view of the finances of the United States for a century, which must be of great interest to all economists. There is also much information of a political and personal nature contained in the history of the foreign loans made by the United States and by individual states, including some description of the repudiated debts of Pennsylvania, Missis-

sippi, and other states. The early loans made through Dr. Franklin, John Adams, etc., in France and Holland, from 1776 to 1795, are dwelt upon minutely; and the transactions of Beaumarchais, the financier, author, and publisher, are related at some length. Statistically, the presentation of debt, aggregate wealth, and taxation, is more complete by far than was ever made before for the United States; and, when these statistics are viewed in the perspective of past history, they confirm the wonderful economic resources of a democratic republic like ours. They show that no amount of debt hitherto imposed has prevented the country from increasing rapidly in wealth and financial power, although there are local debts which may remain unpaid for a long time; and that the aggregate debt of the country is now fast decreasing, while the aggregate wealth is gaining more rapidly than ever. That such should be the case so soon after the most costly and desolating civil war known to modern history, is remarkable; but there can be no other interpretation of the figures presented in this volume.

In round numbers, the aggregate wealth of the United States in 1880, was, by careful estimate, $43,600,000,000, of which not quite $17,000,000,000 was that year assessed for taxation. This is between two and three times as much as was the aggregate wealth in 1860, which did not much exceed $16,000,000,000, or less than the taxed valuation of 1880. The aggregate debt of the country in 1880 was a little less than $3,000,000,000, or between six and seven per cent of the estimated wealth. Of this debt, the national government was responsible for $1,942,000,000; the separate states, counties, cities, etc., for $1,048,000,000. This was the *net* indebtedness, which had in 1880 been decreasing for some years, and has since diminished by at least $400,000,000 in the aggregate; so that we probably shall enter the year 1885 with a net debt of about $2,500,000,000, while our population has increased from 50,000,000 in 1880 to 58,000,000, and our wealth to at least $50,000,000,000. The taxation for state and local purposes upon the valuation of 1880 was about $302,000,000, while the national expenditure drawn from imposts and excise was not far from the same sum. This would be an aggregate taxation of less than fourteen dollars a thousand, which is considerably less than they are taxed in Massachusetts, where even the state and municipal taxes often amount to more than that. The *per capita* distribution of local taxation in different sections of the country is curious; being highest in California ($14.60), in Nevada ($14), and in Massachusetts ($13.64), while in the two Carolinas it is only about $1.50, and in Alabama $1.63. Of course this high *per capita* tax implies great wealth in the community and consequently the richest states have the largest percentage of local taxation, considered with regard to the individual tax-payers. Thus Massachusetts, with an assessed valuation of nearly $1,585,000,000, and a population of less than 1,800,000, in 1880, raised that year nearly $24,500,000 of local tax, besides what she paid into the national treasury; while Texas, with a population nearly as great as that of Massachusetts, but with a valuation of property less than a third part as large, raised by taxation only $4,568,716, or less than a fifth of the Massachusetts taxation. Yet the Texans probably feel their light taxes more than the people of Massachusetts feel their heavy burdens.

For a similar reason the debt of a state is often, perhaps almost always, largest where property most abounds to pay the debt with. This does not hold true of all the southern states, some of which have incurred great debts that bear no proportion to the property of the tax-payers. Thus Louisiana, with a population of 940,000, and an estimated wealth of $422,000,000, had a debt of $42,866,000; while Wisconsin, with a population of 1,316,000, and wealth estimated at $969,000,000, had only $11,876,000 of debt. Virginia's estimated wealth was, in 1880, $693,000,000, and Connecticut's, $852,000,000; yet the latter had only $22,000,000 of debt, while Virginia had $42,000,000. In these statistics we include both the state debt, and the debts of counties, cities, etc., within each state; and we give the net indebtedness after allowing for sinking-funds, etc. The three states of largest estimated wealth (New York, Pennsylvania, and Massachusetts) had then the largest debts, — New York, $218,723,000; Pennsylvania, $106,133,000; and Massachusetts, $91,284,000. These amounts seem vast, and are so; yet Massachusetts had $30 of wealth for every dollar of debt, New York $35, and Pennsylvania more than $50. It is curious to observe, however, to what a great and varying extent this wealth escapes taxation; for, while more than half of Massachusetts's property (57 %) is taxed, only a little more than one-third is taxed in New York (34.8 %), and in Pennsylvania less than one-third (31.2%). The New-England states generally tax property more closely than the other states, the

[t]age of taxed property rising in Rhode [Island] to 60, though it falls in Connecticut to [..] and in Vermont to 30. In Vermont, [th]e tax is very small (only $1,745,000); New Hampshire, with scarcely more [popula]tion, raised $2,698,000 by taxation, and [Rhode] Island, with 56,000 less people, raised [..],000. The estimated wealth of Rhode [Island], however, was $420,000,000, while that [of Ver]mont was but $289,000,000, and that of [New H]ampshire, $328,000,000.

[The] mode of exhibiting property, debt, taxa[tion, e]tc., by pyramidal diagrams, — the largest [a]t the bottom, and so on, upward, — is a [very e]ffective one to the eye, far more so than [the ta]p-form of making such statistics impres[sive]. A map, and an arrangement of divided [squares a]nd parallelograms, are also used to illus[trate t]he ownership of the national debt, etc. [Such] devices are a novel and increasing fea[ture o]f statistical reports, and are doubtless [useful] to the general and casual reader; but [scienti]fic inquirers must be warned against [putting] too much of them. Statistics them[selves], in their most exact form, are apt to [mislea]d as soon as comparisons are attempted; [for th]en a multitude of qualifying circum[stance]s come into view, or, if not seen, make [the re]sult of the comparison deceptive. To [make t]hese statistics still less exact by redu[cing t]hem to the pictorial form, introduces a [new el]ement of error. The investigator must [therefo]re be prepared to see these general views [prove] dissolving views, as he extends his [inquiry] into the real facts, which the best col[lected] statistics do but disguise with a thicker [or thin]ner veil of imperfect classification.

[T]HE ABORIGINES OF CHILE.

[Los ab]oríjenes de Chile. Por Jose Toribio Me[din]a. Testo i láminas. Santiago, *Imprenta [Gutte]nberg*, 1882. 427 p. 4°.

[The] original sources on which we must de[pend f]or a knowledge of the ethnology of Chile [are di]fficult of access, and Señor Medina has [perfor]med a meritorious work in collecting them [in one] volume. Nor is it a mere compilation. [To a] very full description of the Araucanian [tribe]s he adds a discussion of the archeo[logic] relics of that country, such as up to the[..]t we might have sought in vain. Some [of his] conclusions will be read with interest.

[Alth]ough no unequivocal signs of quaternary [man h]ave been found in Chile, Medina men[tions t]wo or three discoveries of stone imple[ments a]t great depths, one of which, as figured, has every appearance of a genuine quaternary celt. As is well known, in the contiguous territory of the Pampas, Ameghino has described undoubted and abundant human remains from quaternary deposits. At any rate, the state of preservation of the remains in the graves of the Araucanians seems to leave no doubt that they were relatively a late immigration. To the antecedent population the author attributes the curious petroglyphs which are not uncommon on the Chilian rocks. His effort, however, to make it appear that this earlier people was of a more civilized type, cannot be said to be successful.

Appended to the text are two hundred and fifty-two lithographs of archeologic finds. They include articles in stone, copper, silver, bronze, and pottery. Those in stone present some forms which are not at all, or not often, found with us. Such are the rounded and polished sling-stones,— a weapon popular in South America, but scarcely known in the northern continent. Stone implements for net-making are another curiosity. They are of the shape and size of a cigar, with grooves around each end. Perforated circular stones, about three inches in diameter, are extremely common, and, the author thinks, were used principally to add weight to agricultural implements, — a quite improbable theory. Both the stone implements and the pottery present markedly different degrees of technical skill. This the author explains chronologically, attributing the ruder to a much more ancient date; but the opinion that they merely represent different degrees of contemporary skill is equally probable.

Shell-heaps are numerous along the Chilian coast, some of them six metres in height; but mounds, earthworks, or walls are not described. No fresh information is furnished on the Araucanian language, and this part of the volume has slight value. The history of the Incarial conquest is detailed at length; but the influence of the Incarial culture on the southern tribes, which was very widely felt, is not allowed its proper prominence.

NOTES AND NEWS.

The Chesapeake zoölogical laboratory of the Johns Hopkins university was stationed this year at Beaufort, N.C., and was open from June 1 to Sept. 19. Owing to the illness of the director, it was most of the time under the charge of Prof. H. W. Conn. The embryology of echinoderms, annelids, and medusae, formed the principal studies. Dr. Brooks nearly completed his monograph of the medusae of Beaufort, and studied the embryology of Eutimia, besides

making some observations on the metamorphosis of stomatopods, to be incorporated in his report on those of the Challenger expedition. Dr. Conn completed his work on the development of Thalassema, and nearly finished a monograph on the crabs of Beaufort, on which he had been engaged for three years. He also studied the development of Serpula, and prepared a paper on larval forms. Dr. Donaldson investigated the physiology of marine vertebrates, making many experiments to determine the relative susceptibility of the different classes to poisons of vegetable origin. He also carried on a series of experiments to determine whether the current theory of digestion in Actinozoa is correct, and reached the conclusion that it was not. Mr. Bateson of England, who carried on his studies by a grant from the Royal society, completed his investigations upon Balanoglossus. Dr. Osborn studied the embryology of Fulgur and Neptunia, and the origin of the body-cavity and reproductive organs of gasteropods. Altogether, ten persons were engaged the whole or a portion of the time in study at the laboratory, and the result of their work has been of the highest importance.

— The first number of the seventh volume of the *American journal of mathematics*, which has just appeared, bears the name of Simon Newcomb, the successor to the chair of mathematics in Johns Hopkins university, as editor.

— The Hydrographic office reports that the bark Nellie T. Guest, which arrived at St. John, N.B., Oct. 20, from Barrow, on the 6th of October encountered in latitude 46° 10′ north, longitude 43° west, a cyclone, during which she lay four hours with decks full of water. Three bags of oil were towed over the weather side, and assisted greatly in smoothing the sea.

— By special request, Sir William Thomson delivered a lecture in Hopkins hall, Baltimore, Wednesday, Oct. 15, on the rigidity of the earth.

— The college for an advanced course of professional study for naval officers, to be known as the Naval war college, will be under the general supervision of the bureau of navigation. The principal building on Coaster's Harbor Island, Newport, R.I., has been assigned to its use, and has been transferred, with the surrounding structures and the grounds immediately adjacent, to the custody of the bureau of navigation for that purpose. The college will be under the immediate charge of an officer of the navy, not below the grade of a commander, to be known as president of the naval war college, who will be assisted by a faculty. The course of instruction will be open to all officers above the grade of naval cadet. Commodore S. B. Luce has been assigned to duty as president of the college.

— The Royal astronomical society has elected Prof. Edward S. Holden, director of the Washburn observatory at Madison, Wis., one of its foreign associates.

— The first annual meeting of the New-England meteorological society was held in Boston on Tuesday, Oct. 21. Sixty-four new members were elected, and the following communications were made: Rain-gauges, by Mr. Desmond Fitz Gerald of the Boston water-works; Rainfall maps, by Mr. W. M. Davis of Harvard college; Weather-observers in New England, by Professor Winslow Upton of Brown university; Establishment of a meteorological station on Blue Hill, Mass., by Mr. A. Lawrence Rotch of Boston.

— Mrs. Dr. Sophie Kowalevski has been elected teacher of mathematics in the new university at Stockholm. As Dr. Kowalevski read last winter a *privatissimum* on partial differential equations with noteworthy results, a new professorship was established for her in the university.

— The facts made use of in Hudson's 'Cause, nature, and prevention of seasickness,' are collected from the author's own experience of twenty-five years at sea. The book lacks a little in physiological accuracy. It, however, is a contribution to a form of treatment which is fast gaining in popular favor, namely, preventive medicine. The author concludes, that by the proper adjustment of the body to gravity and the ocean, through muscular relaxation, seasickness may be avoided.

— Hirsch, the well-known French engineer and author, reports to the Commission centrale des machines à vapeur the results of experiments upon the production of the superheated condition in the water of steam-boilers. Studying the history of such phenomena so far as they are recorded, and conducting a somewhat extended series of experiments, the conclusion was finally reached, that there is no evidence, up to the present time, that boiler-explosions may be caused by the conditions studied, or that such conditions ever arise in practice. If they occur at all, it is only in extremely rare instances, and as a consequence of a coincidence of circumstances seldom to be observed, and which are neither well understood nor well defined. The use of the thermometer is advised to determine the facts bearing upon this question. The commission to which the report is made approve and adopt these conclusions.

— The latest use to which the electric light has been put at the London health exhibition is the illumination of a baker's oven with a plate-glass door. The light was from two incandescent lamps, driven by a Victoria brush-machine, which were inside the oven, where the temperature was from 400° to 600° F., the whole oven being distinctly visible. No more burnt bread!

— The reduction of the French photographs of the transit of Venus, taken Dec. 6, 1882, gives a polar flattening of the planet about the same as that of the earth, viz., $\frac{1}{303}$. From measures during the transit of 1874, Lieut.-Gen. Tennant derived a compression, in the north-south direction, of $\frac{1}{259.3 \pm 77.6}$. There appears, thus, a strong presumption of a real flattening in this direction; which, however, is to be noted as inconsistent with the hitherto received determinations of the inclination of the equator of Venus to the ecliptic.

— Prof. E. S. Holden, director of the Washburn observatory of the University of Wisconsin, has lately collected all the data available for a discussion of the law of distribution of the fixed stars, so far as this is determinable from the method of star-gauging. The data were collected from a comparison with the results of a series of star-gauges in progress with the fifteen-inch equatorial of the Washburn observatory; and they include, 1°, the 683 previously published gauges of Sir W. Herschel, with the places brought down from 1690 to 1860; 2°, the 405 unpublished gauges of Sir W. Herschel, extracted from his observing-books, and generously placed at Professor Holden's disposal by Lieut.-Col. John Herschel (these also reduced to 1860); 3°, 500 counts of stars from the published charts of Dr. C. H. F. Peters; 4°, 983 counts of stars from the unpublished charts of Dr. Peters, from the Paris charts as revised by him, and from the unpublished ecliptic charts of Professor Watson; 5°, 856 counts of stars from the unpublished and published charts of Dr. J. Palisa. These, with the data from Sir J. Herschel's 605 southern gauges, and Celoria's *durchmusterung* of the stars between 0° and + 6°, complete the very valuable collection of data which Professor Holden has brought together in convenient tabular form, and from which one of his most important conclusions is, that the method of star-gauging must be applied to the study of comparatively small regions, and that the results from these are then to be combined into larger groups. Professor Holden hopes that these tables may serve the valuable end of finally disposing of the fundamental assumption that the stars are equally scattered in space, and may bring about the study of their distribution on a more general basis.

— Caspar Johann Bismarck was the editor, in 1694, of one of the most important geographical treatises of the seventeenth century, — the 'Introductio in omnem geographiam' of Philip Cluver, which passed through many editions between 1629 and 1730, and was annotated by various *savants*. Further investigation will be required to determine if this Bismarck belonged to the particular family which has produced the great German chancellor. He was, however, a native of the same region, — Wolfenbüttel in Braunschweig, a town about sixty miles west from Magdeburg. About fifty miles north from Magdeburg, a small town exists which seems to have given its name to the Bismarck family, though the orthography differs slightly. This village is situated in Altmark, a short distance from the River Biese; and its name, 'Bismark,' probably signifies 'market of the Biese.' The name of Bismarck is associated with geographical matters in another way. Before the revolution the students of the university of Orleans, which was then in a flourishing condition, were divided, as was then the fashion, into six 'nations,' two of which were the Normans and the Germans. At this time a certain Christopher de Bismarck was quaestor of the Germanic nation. In that capacity, according to Monseigneur Dupanloup, he held a disputation, celebrated in the annals of the university, with the Normans, claiming that Denmark and the Danes, in spite of their community of origin, belonged, not with the Norman, but with the Germanic nation.

— *Engineering* states that "the pneumatic machine employed by Wroblewski in liquefying and evaporating ethylene and oxygen to produce intense colds has also been recently used by him to evaporate liquid marsh-gas. He has thus obtained a temperature of − 155° C. to − 160° C., which is the temperature of ebullition of the liquid gas. It is a useful temperature as coming between the temperatures of −144° C. and −184° C., which are obtained with ethylene and oxygen; but it varies with the degree of purity of the gas. Oxygen, atmospheric air, nitrogen, and carbolic oxide, cooled with the marsh-gas, can be liquefied under feeble pressures, so that a chemist who succeeds in producing pure marsh gas easily and economically, will render a service to science."

— The periodical report of the City guilds of London institute for the advancement of technical education has just been issued, and gives an extended account of the examinations held at the end of May. A considerable increase is shown in the number of candidates, the total this year having been 3,635, as against 2,397 in 1883. The number of centres has been increased from 154 to 164. Carpentry and joinery were new subjects, and attracted 369 candidates; but metal-plate working, only 2, who did not succeed in passing. The results were considered satisfactory, but show the urgent need for more systematic technical instruction for those who are employed in factories and workshops.

— Dr. Schweinfurth is spending three months in Berlin, preparatory to a new journey through the Egyptian deserts, on behalf of the Berlin academy of sciences, which he will undertake next winter. Though botany is his own specialty, the survey of the desert forms the main object of his journey.

— According to the *Colliery guardian*, Mr. W. E. Garforth, mining-engineer of Normanton, has succeeded in perfecting an invention for the detection of firedamp in mines, which is as remarkable for its simplicity as for its efficiency. It consists of an ordinary India-rubber ball, without a valve of any description; but by the ordinary action of compressing the ball, and then allowing it to expand, a sample of the suspected atmosphere is drawn from the roof or any part of the mine without the great risk which now attends the operation of testing for gas, should the gauze be defective. The sample thus obtained is then forced through a small protected tube upon the flame, when, if gas is present, it is shown by the well-known blue cap and elongated flame. From this description, and the fact that the apparatus can be carried easily in the pocket, the value of this adjunct to the safety-lamp will be apparent. It is thought that explosions are caused frequently by the fire-trier himself, and that his death prevents the cause from being fully ascertained. This danger will now be altogether avoided, and it is said that the detector has been tried at several collieries with completely satisfactory results.

—The *Athenaeum* states that Sir Richard Owen's 'History of British fossil reptiles,' which has been upwards of forty years in preparation, is now ready for publication by Messrs. Cassell. On the preparation of the 268 plates with which the volumes are enriched, great labor and attention have been lavished. The edition consists of 170 copies only, each copy being signed by Professor Owen; and the plates from which the illustrations have been printed have been destroyed.

—The time of the glacial period in New Zealand has been studied by R. von Lendenfeld, whose survey in the New-Zealand Alps, partly corroborating and partly extending the results of Dr. von Haast's surveys, shows that the present glaciers are as large, and extend down as far, as those in Norway, where the mean annual temperature is 3° C., whilst in New Zealand it is 11° C. The greater expanse of water in the southern hemisphere, and the consequently greater amount of humidity in the air, and more copious rain and snowfall, are considered to be the cause of this. The sounds in the south-west coast are similar to the fiords in Norway, and the alluvial deposits at their upper ends are small. Scooped out originally by flowing water, these sounds remained unchanged during the period of subsidence of the land, and were not filled up with *débris*, because large glaciers occupied them during that time. As soon as these glaciers disappeared, the formation of the alluvial deposits commenced; and from the fact that the latter are small, and increasing rapidly in size from year to year, the author considers that the glacial period in New Zealand must have been very recent.

—The committee of Lloyds has received from the London board of trade a report concerning the surface-ventilation of the cargo of 2,050 tons of coal carried in the Sutherlandshire from Hull to San Francisco last year. The ship was fitted with tubes to enable the master to ascertain the temperature of the body of the cargo, as recommended by the report of the royal commission appointed to inquire into the spontaneous combustion of coal in ships. The voyage was perfectly free from fire. The commander, Capt. Inglio, highly approves of the tubes, and will continue testing the temperature. A record was kept, and the figures are on record at Lloyds.

—England, so far, is not taking a very prominent part in the International exhibition to be held at Antwerp next year, only about two hundred firms having applied. France especially takes a prominent part, the French government having voted seven hundred and fifty thousand francs towards the expenses of the undertaking, and appointed two official commissions; while the municipal council of Paris has promised a grant of a hundred thousand francs for the purpose of sending workingmen delegates from that city. Prince Rudolph of Austria has also influenced the Vienna chamber of commerce to make strong efforts on behalf of the concern. The United States will be well repesented; and the Dominion of Canada better so than the mother-country, as it gives both official recognition and a substantial credit. Germany is also making strong efforts to be officially represented.

—Mr. Clermont Ganneau, the French archeologist, has been describing for the benefit of his countrymen the antiquities of Palestine now treasured in London, and advises the formation of a vast Palestine museum and library, one of the departments of which should be "an extensive and animated panorama of the Holy City, and dioramic views of the principal localities and of characteristic scenes of popular life in Palestine, in order to add to this scientific combination an irresistible element of attraction and success. In short, in the centre of London should be created a representation as faithful, varied, and complete as possible, of Palestine, past and present, which would be as a living commentary on the Bible." England, says Mr. Clermont Ganneau, being 'so passionately fond of biblical studies,' would be the country most likely to carry out his ambitious project.

—Mr. Wood Mason of the Calcutta Indian museum has recently drawn up a report on those insects from which the tea-gardens of Assam most suffer. He says the tea-bug or 'mosquito-blight,' and the tea-mite or 'red spider,' are the only two insects which are at present known to do such injury as to materially diminish the profits of the owners. Both these insects pass their whole lives on the tea-plant, and have never been found on any other plant. Such, at least, is the result of the most careful investigation. The mite lives in societies on the upper portion of the full-grown leaves, beneath an exceedingly delicate web which it spins for itself as a shelter. It punctures the leaves, and then pumps out the liquid contents of the epidermis. The only remedy which has been discovered to check their ravages, and it has not proved very effectual, is to sprinkle the affected bushes with muddy water. The tea-bug is still more destructive, and particularly to the trees of the milder juice; for those which afford a strong and rasping liquor enjoy an almost complete immunity from its attack. Mr. Wood Mason appends to his report engravings of these destructive creatures.

—The *Cape times* says that a gigantic earthworm has been sent from the colony to Mr. Frank Biddard, the prosector of the Royal zoölogical society, who has been desirous of obtaining one of these monsters for scientific purposes. The Rev. G. Fisk, F.Z.S., with whom Mr. Biddard has corresponded on the subject, received the worm from Mr. H. W. Bidwell, who found it in the botanic garden at Uitenhage. The longest measurement of the creature yet taken reaches six feet five inches; but it is thought, if it were drowned, the measurement would extend to ten feet, this mode of extinction having an extremely relaxing effect on the frame or substance of the worm. The surface of the upper portion of the body shows a bright green color, of variable intensity, but otherwise it is a loathlful animal. Lumbricus microchaeta is the name by which it will be immortalized in the records of the Zoölogical society.

of heat as a mode of motion. He was the first to propose the use of an absolute thermodynamic scale for the measurement of temperature; and, in his paper on the electrodynamic qualities of metals, he presented his discovery of the electrical convection of heat, and of a great number of important relations between thermal and electric properties of matter. Perhaps the most striking of the results to which his studies in thermodynamics led him was the theory of the dissipation of energy.

The almost random list of papers which we gave above was designed to illustrate the variety, rather than the importance, of Sir William Thomson's work; but it is hardly necessary to say that many of his researches on subjects very wide apart have been profound and important. His great investigations on the subject of vortex motion, to which he has devoted much attention for so many years, his researches on the tides, his contributions to hydrodynamics, his researches on the physical condition of the earth, have all been of signal importance; and the highly original method of attacking the problem of the wave-theory of light, of which he gave some account in his recent Johns-Hopkins lectures, has long been occupying his mind, and may fairly be expected to give rise, in the not very distant future, to results rivalling in value any of his former discoveries.

Besides his contributions to the advancement of pure science, Sir William Thomson has been the originator of improvements and inventions of the highest immediate practical utility. The most prominent of his services of this character have been those connected with submarine telegraphy. Space does not permit our entering into details: but it may be mentioned, that he discovered the law of the 'retardation of signals,' which was the chief preliminary difficulty to be faced by those considering the feasibility of using a cable stretching under the ocean, from the old to the new world; that, to meet this difficulty, he invented the 'mirror galvanometer,' which, when the cable of 1858 came to be laid, was employed during the brief period of its successful operation; and that, when this cable broke, on account of difficulties and imperfections connected with its submersion, he devoted himself with signal success to improving the construction of cables, and the mechanical arrangements for their submersion.

The very great benefits conferred upon the world by the labors of Thomson and others, who contributed to overcoming the difficulties which were so triumphantly surmounted in 1866, were recognized by the bestowal upon them of the honor of knighthood. Other important improvements in telegraphy are due to him, but we must omit mention of them.

the board. While it has thus far apparently been composed of men of the best character and of high scientific attainments, there is no certainty, possibly but little probability, that the same standard can be maintained in the future. Any renewal of appropriations, or increase of powers, would be likely to make the board attractive to the place hunter.

Coming at this time, the St. Louis conference has an unusual significance. This voluntary assembly of representatives of the only public bodies possessing any real power to deal with epidemic disease, or questions of public health, might very easily be transformed into a national organization, certain to control, within the above limits, public opinion. Let the central authority be composed of delegates selected by state boards of health, when such boards exist; when there are none, by the governors of the respective states. Such a body may be convened at any time, in case of need: ordinarily, one or two sessions annually would be sufficient. An executive committee of moderate size, with permanent officers at Washington, could attend to such routine work as congress might see fit to intrust the board with. It is not advisable to burden a board of health with great patronage or much executive power. It should be largely devoted to scientific investigation of epidemic disease. These must, of necessity, be conducted on a scale so extensive that no private laboratory, public institution, or state board of health, has been or will be able to undertake them. The fact that the members of this association would be also members of powerful state organizations, would secure the co-operation of the various states, and would legitimately control, in a high degree, congressional action, and, as a board of consultation, would, when applied to, speak with an influence that no department at Washington could afford to neglect.

THE secretaries of war and of the navy have indirectly raised what may prove a troublesome question respecting the duties of members of the National academy of sciences, who are also officers of the government. Our readers may remember, that, when the organization of the surveys was reported upon by the academy some years ago, a very strong protest against its conclusions was made by the chief of engineers, in which one of the strongest points was, that the men who conducted such surveys were not represented upon the committee which made the report. When a question very similar was submitted to the academy last summer, in order to elicit a report upon the coast and geological surveys, the signal-office, and the hydrographic office, the policy was adopted of putting an officer of the army, and one of the navy, upon the committee. When this fact became known to the heads of the departments, they decided that no officer of the government should take a place which might require him to report upon the policy of his chief; and both members, therefore, withdrew from the committee.

Without discussing the application of this principle in the present case, we hope it will in the future be so limited and defined as not to cripple the academy in cases where it might happen that there are no experts available except those who are officially connected with the government. During a state of war the most important questions submitted to the academy would probably pertain to instruments and appliances to be used in warfare, and it would clearly be impossible to omit from its committees the very men who knew most about the subject-matter submitted. The academy is, we believe, the only government organization now existing, or which ever has existed, the members of which were required to give their services to the government without charge whenever called upon. As such, the body would seem entitled to a large measure of consideration on the part of the government, which will be increased when we call to mind the value and importance of its reports. No amount of labor and research has been spared in cases when methods of defrauding the revenue by the chemical manipulation of products had to be looked into. The efficiency which

Two important improvements in navigation are also due to Sir William Thomson, — his improved mariner's compass, which has been adopted, we believe, by the British and French navies, and which is extensively in use upon large vessels generally; and his more recent invention of a navigational sounding-machine — navigational, as distinguished from the deep-sea sounding apparatus devised by him for purposes of research. The navigational sounding-machine permits of soundings being taken at intervals of a few minutes, in water of the depth of a hundred fathoms; and thus it gives navigators — who, it is to be hoped, will soon avail themselves of this new safeguard — the means of easily getting warning of danger long before it is imminent.

We cannot conclude even this brief and imperfect sketch of Sir William Thomson's work, without mention of the great treatise on natural philosophy upon which he and Professor Tait have united their labors.

To those who have had the privilege of personal contact with Sir William Thomson, his name will always be associated with the idea of personal lovableness and kindness, gentleness and modesty, even more than with that of scientific greatness. Every one who attended his recent lectures must have been deeply impressed with the truth of Helmholtz's remark, that "the gift to translate real facts into mathematical equations, and *vice versa*, is by far more rare than that to find the solution of a mathematical problem; and in this direction Sir William Thomson is most eminent and original." But he could hardly fail to be as strongly impressed with his possession, in an equally rare degree, of genuine and unaffected modesty, enthusiastic appreciation of the achievements of others, and tender consideration for all those whom the chances of time bring into connection with him, whether it be for a lifetime of friendship, or for a few fleeting weeks of union as teacher and pupil.

The accompanying portrait is after a crayon from a photograph taken in Montreal during the recent meeting of the British association.

THE NEW VOLCANO OF THE BE SEA.[1]

SINCE the appearance in *Science* (vol. iii 51, pp. 89–93) of Professor Dall's paper this new volcano, Lieut. G. M. Stoney, U. has embodied in an official report the resu a personal examination of this locality. be recalled that when Professor Dall sur the island of Ioanna Bogoslova (St. Jol theologian) in 1873, seventy-seven years its appearance by violent upheaval, he f that with the exception of the small rec Umnak, and of the rocks within a shor tance of Bogoslova, there was water mor eight hundred fathoms in depth on all si the island.

In October, 1883, a violent disturbance forth, contemporaneous almost with t Mount St. Augustine, described in *Scienc* iii., No. 54) by Professor Davidson, and ing, as was believed, in the formation of island. The last reports of this, while ag materially with Professor Dall's conclu show, that, while no new island was fo Bogoslova was extended; that the old v was supplemented by another, which i active: and that where was relatively depth of water there is now a land-forn nearly three hundred feet in height.

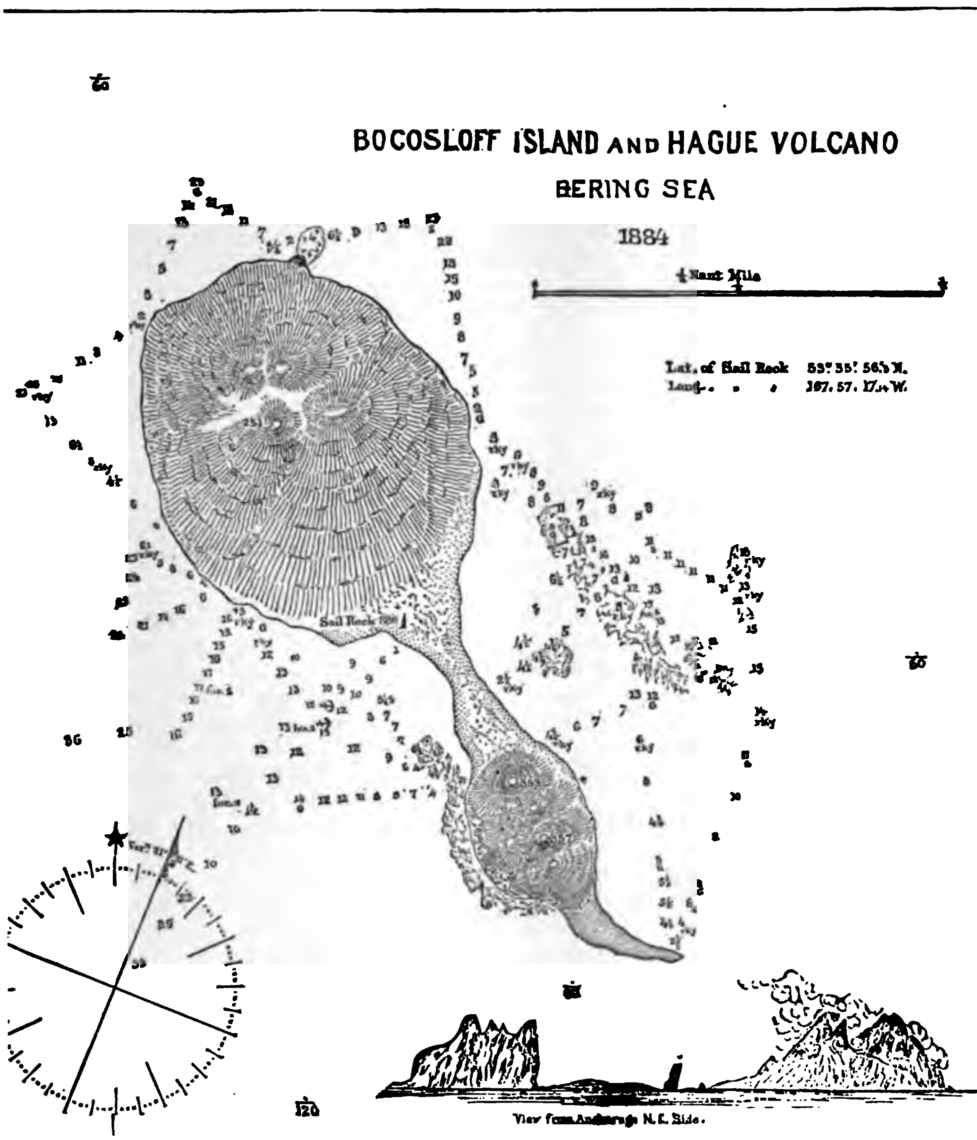
Lieut. Stoney reports that the new v was first seen by Capt. Hague in O 1883, and suggests for it, in lieu of the 'Grewingk' proposed by Dall, that of i coverer.

There is no lack of definiteness as to th of this new formation, all accounts ag that the violent eruptions began early in and culminated about the 16th of October "a dark cloud of indescribable appearan ered the sky northward from Unalashk hung very near the earth for some tin cluding the light of the sun, and accom by a rise of temperature. In about h hour this cloud collapsed, and covered th with dull, gray, cottony ashes of e lightness." During this period the vol Makushin, on Unalashka, was quiet, t shocks were felt there; and in the subs survey, Stoney found that "the dust an which fell in Unalashka were the same a seen on the sides of the new volcano."

On the 27th of May of this year, Ston after leaving this last island, the smoke new volcano, then distant forty-five mil bearing south-west; and by three A.M. 28th it was in plain view, the base d

[1] Communicated by the U. S. hydrographic offi

e crater, save at rare intervals, hidden ises of black and whitish smoke. What and Dall supposed to be a new island en seen to be a new formation, connected e old island by a low sand-spit. Within ve a narrow bay, well protected from ly winds, was sighted; and, running in ı thick volumes of sulphurous smoke, hooner was anchored, amid bubbling in thirteen fathoms, with a sand and gravel bottom. This anchorage lay to the northward and eastward, and was supposed to be the best available; but subsequent surveys proved that another roadstead to the southward



and westward was better, both in shelter and holding ground.

Three days were occupied in surveying the volcano; a hasty reconnoissance, made immediately after arrival, having satisfied Stoney that with the exception "of the occasional

shaking-up by shocks, and of the persistent odor of the sulphur," the anchorage was a safe one. The first impression of the volcano was its likeness to an immense lime-kiln; though when the intermittent masses of smoke from the crater and from the fissures, which in some cases extended to the water's edge, gave a clearer view, its jagged mouth and sides dispelled the illusion. At intervals the side crevices gave out only faint, pale ribbons of smoke, and then it was found that their edges were covered with incrustations of sulphur and of a white crystalline formation. A thermometer inserted an inch and a half below the crust reached its limit (250° F.) in a few seconds, the air temperature being at the same time 40° F. The crust was warm, though not unbearably so; but a stick placed against the heated rock blazed instantly.

As a rule, vibratory motion of the whole mass could not be discovered; though, with instruments, the explorer believed vibrations could be continuously detected. This statement rests upon the fact, that, when taking observations with the artificial horizon, the mercury was agitated so constantly as to permit accurate sights only at long intervals. Upon one occasion, while climbing the sides of the volcano, there was a most sensible vibration of the whole mass; and at the anchorage many shocks, both single and successive, were felt.

Rumbling sounds, and a dull roar similar to the discharge of distant cannon, were heard at intervals; and, though flames were seen only upon two occasions, yet this is believed to have been due to the little darkness of the season at that latitude.

The mass of the volcano was found "to be of a species of sand rock, with large black rocks scattered about the crust." No traces of lava, and but small quantities of pumice, were found. In some places the sand and cinders were ground to a fine powder, ankle-deep as a rule, but so yielding in places as to prevent an extended survey. The most careful examination revealed no trace of shells, though many of the rocks at the base "looked as if they had been exposed for a long period to the action of the water . . . and some of the rocks under water were still smoking." When the compass was taken ashore, marked local action was so noticeable as to prove the presence of iron.

Near the base of the volcano the water bubbled and broke, as if boiling, but no difference was found in the surface and bottom temperatures; and at the anchorage, where the same ebullition was apparent, there was a difference of one degree only between the same points.

Though one of the party rea
of the crater, no estimate of
depth, and apparent area, coul
repeated measurements the alti
mit was found to be three hu
seven feet. Some discrepan
on the printed hydrography o
example, the reef charted as
Bogosloff to Umnak does not

Birds were found upon the
enormous numbers; gulls, shag
being so numerous, that, "whe
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and such as flew into the smo
ing hill, as many did, imme
The sand-spit on the eastern
base rocks, were the resting-pl
of sea-lions. No fish could b
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CANAL ROUTES BETWEE
TIC AND THE PA

Internal canals, or canals
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and the Bay of Biscay; and
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Besides the Panama canal,
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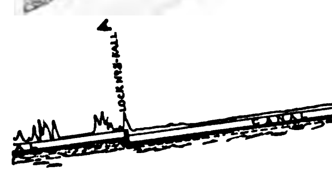
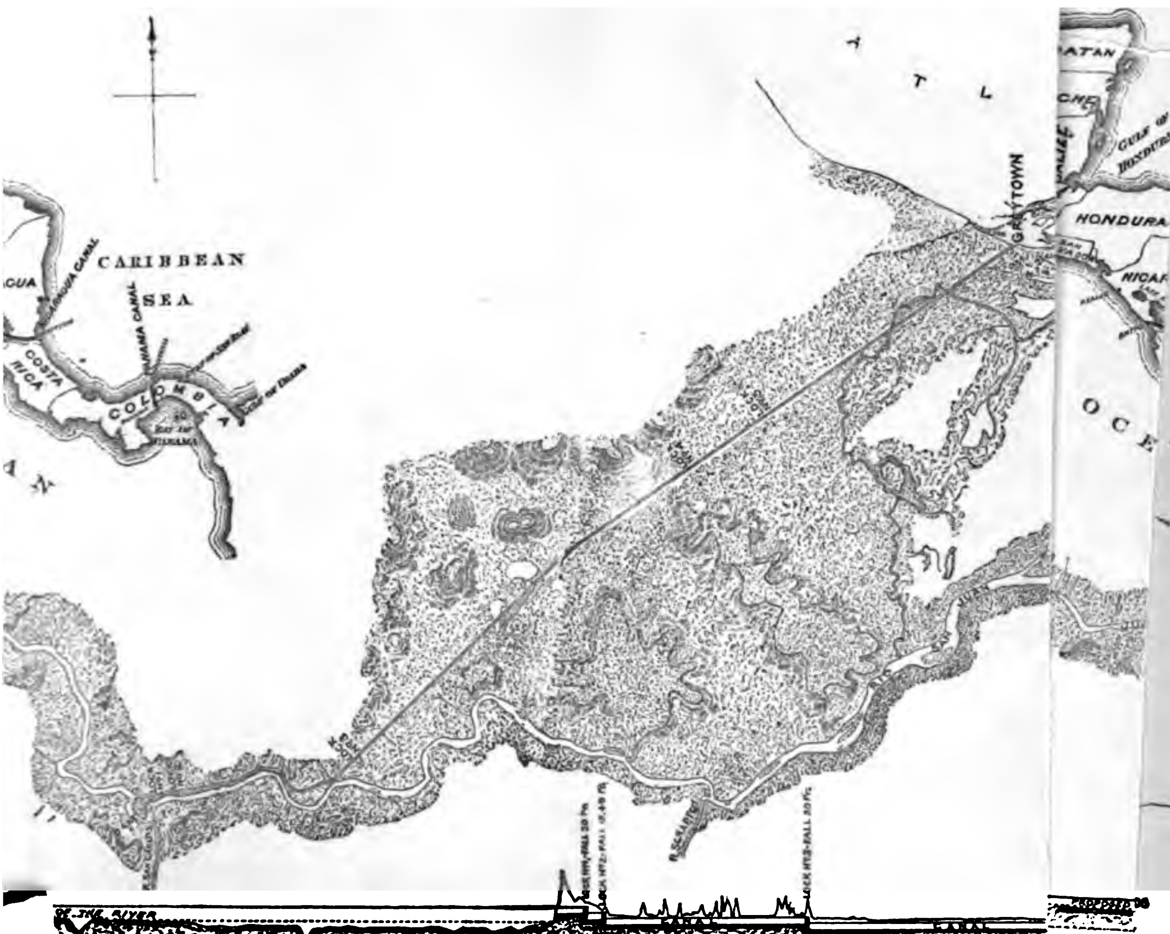
GREYTOWN





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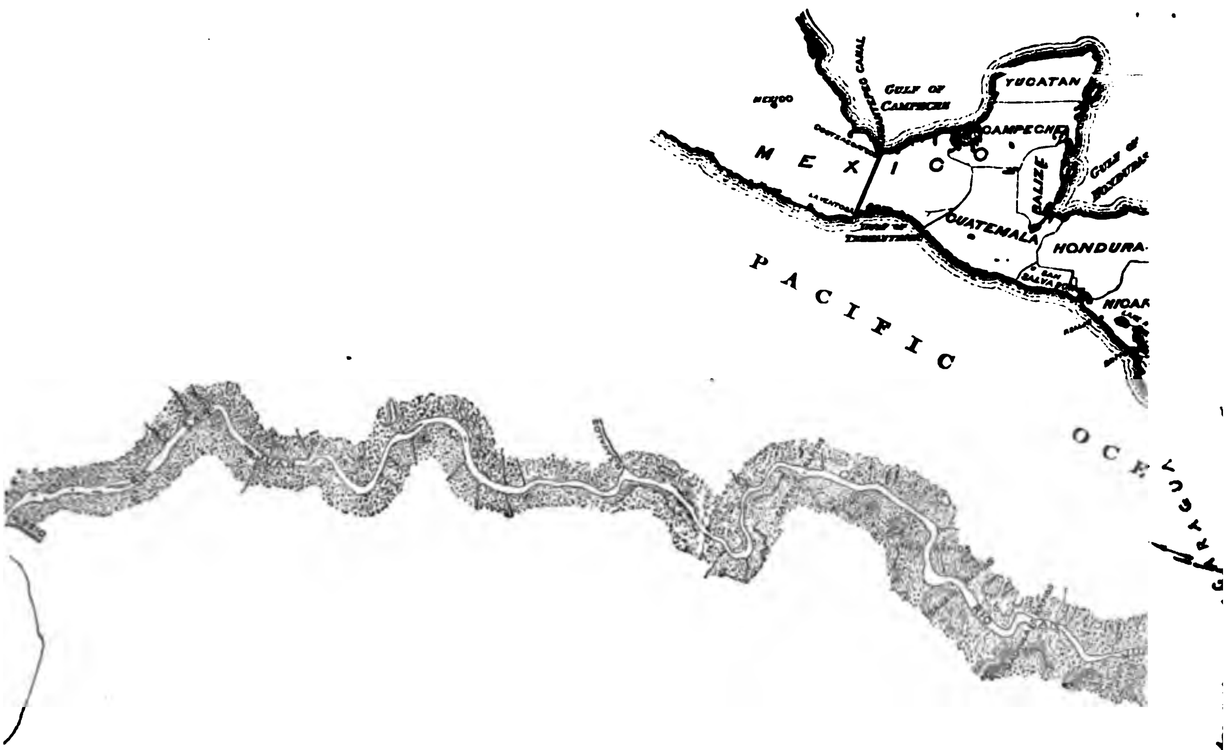
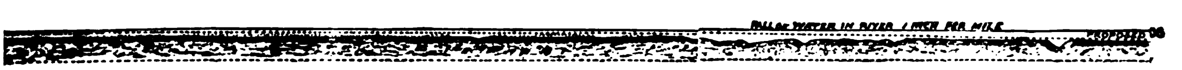




AN AND PROFILE OF THE NICARAGUA INTER-OCE

Compiled from various surveys, by A. G. Menocal, civil engineer, U.S.N.

ffin's Bay to the Navigator,—a vesad entered the ice through Bering saved the crew of the latter from ; thus for the first time solving the passage, and proving it impracticanmerce. Later, he was the first to on the locomotive from Cairo, and, te Robert Stephenson, made a careful ne isthmus, and of the hydrographic ons of the harbors at Suez and Port bsequently he spent three seasons, e staff at great labor and expense, in profile of the Nicaragua route from through Lake Nicaragua, to the ean.

e Lesseps proposes to make the Panabroad enough and deep enough to passage of the largest ships from the the Pacific. Mr. Eads proposes to canal and railway across the Tehuane, and, in cradles adjusted to large rry the vessels from ocean to ocean railway; while Capt. Pim's project canal eight feet in depth, to raise s by hydraulic lifts, and float them low dock on pontoons drawing six ater, claiming that in this way a cross the isthmus as quickly as by ter canal, and that, by clearing the om of barnacles during the passage, aving of time may be effected.

m objects to the Panama route on the at the difference in the height of the spinwall and Panama will render it nd without locks impossible, for veser and leave the canal; that Panama the equatorial calm-belt, where the calms continue ten or eleven months r (his own vessel, the Herald, was miles from the land before reachh of wind), and that on this account a longer time for sailing-vessels to Francisco by the Panama canal than lorn.

, that, when the Panama railway was as expected that large quantities of be shipped over it; but no whaler eached Panama. He estimates that of this route will be not less than 000, or nearly twice as much as that caragua route, the U.S. engineers the cost of the latter at $82,000,000. osed route through Nicaragua (see panying chart) is by a canal from to a dam to be constructed on the River, from there, by the river, to ragua, across the lake, and thence to the Pacific Ocean, making a total distance of 173.57 miles. The surface of Lake Nicaragua is 107 feet above the level of the Atlantic, and the height of the land between the lake and the Pacific is 147.7 feet, requiring a cut of 40 feet to bring the canal to the lake-level. This necessitates a series of five locks between the Atlantic and Nicaragua, and seven between the lake and the Pacific. There was formerly an excellent harbor at Greytown, but it was filled up by the silt coming down the river; and at present there are no good ports on either side of the route, though it is believed that they can be constructed at a moderate expense. It is proposed to change the course of the river so as to prevent the silt from coming down, and then to excavate the harbor at Greytown; while at Brito, on the Pacific coast, a harbor can be made by the construction of two breakwaters.

Nicaragua is 600 miles nearer San Francisco than Panama; and, as stated, sailing-vessels from the latter must make a long *détour* in order to obtain the advantage of the monsoons; making a difference of 2,100 miles, or fourteen days, in favor of Nicaragua, though on the return trip the difference is only about 600 miles, or four days. Although tonnage by steamers is increasing, yet at the present time the tonnage of sailing-vessels largely exceeds that of steamers. The tonnage of sailing-vessels in 1877, in the United States, was twice as great as that of steam-vessels, though at the present time it is only one-third more.

The difference in favor of the route from Nicaragua to Japan, China, and the Sandwich Islands, is over 800 miles, while on the return it is only 600 miles, and to India and Australia, 400 miles. It is also stated that vessels can sail in a shorter time from Nicaragua to Valparaiso and Callao, than from Panama, although the distance is considerably greater. The saving for steamers, however, will not be nearly so great, amounting only to the direct distance between the two Pacific termini; that is, about 1,300 miles for the round trip between Panama and San Francisco, or five days in a ten-knot steamer.

The committee appointed by our government in 1877, consisting of Gen. A. A. Humphreys (chief of engineers), Capt. C. P. Patterson (superintendent of the U.S. coast-survey), and Commodore Daniel Ammen, 'after a long, careful, and minute study' of the several surveys of the various routes across the continent, reported unanimously in favor of the Nicaragua route as possessing "greater advantages, and offering fewer difficulties from engineering, commercial and economic points of view, than any

one of the other routes shown to be practicable."

Admiral Ammen of the U.S. navy, in his speech on the Nicaragua route before the American association for the advancement of science at Philadelphia, said that there were 2,000,000 tons of grain produced on the Pacific coast by English-speaking people, which find a market around Cape Horn, mostly in English ports; and that there were vast quantities of timber-lands, extending from Puget Sound to Bering Strait, with the best quality of lumber, which can be shipped through this canal most advantageously. From time to time, a good many estimates of the tonnage that would use the canal have been made, nine of which, obtained by the U.S. commission, range from 3,000,000 to 6,000,000 tons of freight, and give an average of 3,804,000 tons per year. The estimated toll is three dollars per ton, in addition to the port charges and other dues; but the actual expense to the vessel will depend upon the rule adopted for ascertaining the charge, and whether the tonnage is charged upon the actual amount of cargo carried, or on the gross tonnage of the vessel. The latter, which is the method proposed by Mr. de Lesseps, would make the actual cost about six dollars for each ton of merchandise carried.

"The tonnage of the world in 1870 amounted to 17,963,293 tons, and, in 1879, to 20,395,815 tons. These amounts were made up of steam and sail tonnage, as follows: —

Years.	Steam.	Sail.
1870	2,466,498	15,496,795 tons.
1879	4,366,221	16,029,594 "
Gain in 9 years	1,899,723	532,799 tons.

"From this it will be seen, that, while the sailing-tonnage has actually increased, it has not done so at a rate to compare with the increase of the steam-tonnage, which has been facilitated by many causes, prominent among which was the opening of the Suez Canal. Sailing-vessels cannot use this canal to advantage: hence the increased commerce resulting from its construction has called into existence much of the increased steam-tonnage. It is very probable, that, in the event of the opening of a canal by way of Nicaragua, the sailing-tonnage would increase at a remarkably rapid rate, as the route lies in a region which is highly favorable to sailing-vessels."

GARDINER G. HUBBARD.

CERTAIN PRINCIPLES OF PRIMITIVE LAW.

A DEFINITION of the term 'law,' that will hold good under all circumstances, must be divested of the many theories of its origin, the source of its authority, and its ethical characteristics, which are expressed or implied in customary definitions, and laws must be considered as objective facts. The following definition will perhaps do under all circumstances: *A law is a rule of conduct which organized society endeavors to enforce.*

In civilization, law is theoretically founded on justice; but in savagery, principles of justice have little consideration. There are two fundamental principles at the basis of primitive law: viz., first, controversy should be prevented; second, controversy should be terminated. A third is derivative from them; namely, infraction of law should be punished. These principles enter into primitive law in many curious ways.

It was customary among the tribes of North America for individuals to mark their arrows in order that the stricken game might fall to the man by whose arrow it had been despatched.

A war-party of Sioux surprised a squad of sleeping soldiers, who were all killed at the first volley from the Indians. Their arms, blankets, and other property were untouched, because, the attacking party being large, it could not be decided by whose bullets the soldiers were killed.

It has been widely believed that the practice of placing the property of deceased persons in their graves when they are buried has its origin in religion, and testifies to the universal belief that the dead live again, and will need such articles in their new life. But many tribes of North America who have not yet been long in contact with white men avow, that, there being no owner for the property, its disposition might lead to controversy, and hence it is destroyed. Many examples of this fact have been collected. Ownership to the greater part of property in savagery is communal, some classes of property being owned by the clan, others by the tribe; and for such there is no proper inheritance, as the clan and tribe do not die; but purely personal property is inherited by the grave. It seems probable that such is the origin of the custom of burying various articles with the dead. Subsequently it has religious sanctions thrown about it, as have many social customs.

There is a law, among the tribes of North

a, that superior age gives authority. w is widely spread, and perhaps uni- and exercises a profound influence in ociety, as the occasions for its applica- e multifarious. Like many other of titutions of tribal society, it is woven e structure of tribal language. Lin- have recorded as a curious fact, that in anguages there is no single term for er,' but two terms, — one signifying brother:' and the other, 'younger .' They have also found similar facts to the term 'sister,' and to some other words; but, so far as I know, they iled to observe that the law applies to anguineal kinship names. All of these xpress relative age between the person g and the person addressed. Among tribes the age of an individual is not No man knows his own age; but every oman, and child in the tribe knows his age to every other person in the tribe, are older and who are younger than , — for, in addressing any other person tribe, he must necessarily use a term mplies that the person addressed is older ger. The law that authority inheres in er is a simple and ingenious method of ting controversy.

above is the explanation of another custom observed among savage tribes; , that it is illegal to address a person proper name. Kinship terms are used t address, proper names in speaking of person. It is hardly necessary to state this device controversy is prevented.

nteresting form of outlawry exists among ibes. When a man has frequently in- his clan in controversy with other clans on of quarrels or other outrageous con- is own may decide no longer to defend d will formally announce in tribal council ch person is no longer under their ion. If the person thereafter by his maltreats any member of the tribe, red party may do as he will with the r, and not be held accountable by the of the outlaw.

few illustrations here given are sufficient, , to make clear what is meant by the nt that a large class of savage laws are d to prevent controversy. Many other tions might be given, for they are found y hand.

e especial methods of terminating con- y are widely spread among the tribes of America.

n controversy arises in relation to ownership, the property is usually destroyed by the clan or tribal authorities. Thus, if two men dispute in bartering their horses, a third steps in and kills both animals. It seems probable that the destruction of property the ownership of which is in dispute is common to all tribes.

A second method of ending controversy is by the arbitrament of personal conflict. For example: if two persons disagree and come to blows (unless conflict end in the maiming or killing of one of the parties), it is considered a final settlement, and they cannot thereafter appeal to their clans for justice. By conflict a controversy is outlawed. This law seems to be universal.

The third method of terminating controversy is by the establishment of some day of festival — sometimes once a month, but usually once a year — beyond which crimes do not pass. The day of jubilee is a day of forgiveness. The working of this principle might be illustrated in many ways.

We have thus briefly set forth certain principles of primitive law, in order that the subject of marriage law in savage society, which will form the subject of a future paper, may be clearly understood. Law begins in savagery through the endeavor to secure peace, and develops in the highest civilization into the endeavor to establish justice.

J. W. POWELL.

SIR WILLIAM THOMSON'S BALTIMORE LECTURES.

THE title 'Molecular dynamics' does not give an accurate idea of the nature of Sir William Thomson's recent course of lectures at the Johns Hopkins university. The object of the lectures was to consider the possibility of placing the wave-theory of light upon a perfectly tangible physical basis which should be sufficient to account for all the phenomena. The lecturer stated at the outset that he would be occupied more with pointing out difficulties than with removing them. He expressed the conviction that what takes place in the propagation of light — at least through gases, if not through solids and liquids — can be represented in its essential features by supposing a mass of vastly denser matter in the ether, bounded by a perfectly rigid shell; this shell surrounded at a small interval by another perfectly rigid spherical shell; and so on. Each shell is connected with the one outside it by a number of spiral springs: the precise number of the shells is not a vital matter in the theory, and the actual number may be infinite, i.e., the system of shells may constitute a continuous atmosphere to the molecule. The problem of the modes of vibration of this system is essentially the same as that of a system of particles connected by

springs in a straight line. As for the ether itself, it is to be considered as a substance which may not be an elastic solid, but which, so far as the luminiferous vibrations are concerned, moves as if it were an elastic solid. The lecturer carried on the mathematical discussion of these two dynamical problems — the propagation of waves in an elastic solid, and the motion of a system of spring-connected particles in a straight line — side by side, usually devoting the first half of a lecture to one problem, and the remainder to the other.

It is impossible here to give any specific account of the contents of the lectures; it may be stated, however, that many of the cardinal phenomena of light were shown to be explicable by the hypothesis sketched above, but that the phenomenon of double refraction presented apparently insuperable difficulties, as it has done in all previous attempts to explain it. By proper suppositions regarding the elasticity of the springs (in the mechanical 'model' of the phenomenon given above) double refraction would indeed be produced; but its law would be widely different from that actually observed.

The lecturer was conversational in his manner, made almost no use of notes, and was full of enthusiasm for his subject. The audience was composed of professors of physics from eastern and western colleges, scientific men from Washington, and students and instructors of the Johns Hopkins university. The lectures, while not condensed in form, presupposed thorough familiarity with the physical and mathematical theories involved. A verbatim report of them, from stenographic notes, will be issued in a limited edition, by the use of the papyrograph process. At the close of the course, Sir William Thomson was presented by the class with one of Rowland's concave gratings, as a memento of their connection with him.

NORTH-AFRICAN ARCHEOLOGY.

AT a meeting of the Academy of natural sciences of Philadelphia, Sept. 25, Dr. Daniel G. Brinton called attention to a collection of flint-chips collected at the station of Ras-et-Oued, near Biban, on the south-eastern coast of Tunis, and presented to the academy by the Marquis de Nadaillac. The specimens consisted of flint-chips, arrow-points, and a semi-lunar shaped implement of small size, which resembles the 'stemmed scrapers' found in America. This form was obtained from lower levels below the surface, and is characteristic in France of the later productions of the stone age, especially of that epoch called by the French archeologists 'the epoch of Robenhausen,' from the locality of that name in Switzerland. Chronologically this is regarded as the first epoch of the appearance of man on the globe, the previous implement-using animals being probably anthropoids. These made use of stone only, not having learned the dressing of bone or horn. This view adds to the interest of the query as to the purpose of these scrapers. That they were an important tool to the primitive man is evident from their wide distribution. They have been found in France, in the Crimea, in India, in America (both North and South), and now we have them from Africa. The strata in which they have been found are of great antiquity.

The archeology of the North-African coast has especial claims to attention, as from there, apparently, a very ancient migration advanced northward, passing in one direction through Spain, and in another by way of Malta, Sicily, and Italy. This migration was apparently contemporary with the appearance of the Elephas africanus in Europe. Another point of interest, connected with North-African archeology, is found in the fact that the only locality in the old world where animal or effigy mounds have been reported is in Algiers, near the forest of Tenrit-el-Sad, south of Miliana. As these peculiar structures are so frequent in the Mississippi valley, the coincidence is worth noting.

Prof. A. Heilprin contended, that while on the hypothesis of evolution, no objection could be raised to an assumption which made an animal intermediate between man and the anthropoid apes sufficiently intelligent to understand the full value and manufacture of stone implements, such as were exhibited, yet, as a matter of fact, paleontological evidence had thus far failed to prove that any such use or manufacture had been made of them, as was claimed. Indeed, no evidence was forthcoming to show that the implements were not the work of man himself, despite the fact that no traces of human remains have been found associated with the fragments. The assumption that the advent of man dates only to a given period of the so-called 'stone age' was considered to be purely gratuitous, and to rest solely on negative evidence. Many archeologists concur in the belief that man's remains may yet be found in deposits of a strictly tertiary age.

THE LIMITATIONS OF SUBMARINE TELEGRAPHY.[1]

THE weight of the conductors, says Henry Vivarez in *La lumière électrique*, plays an important part in submarine telegraphy, not merely as a heavy item in the outlay, but as one of the principal factors in laying down the lines, and in taking them up in case of damage. When the conductor is being raised, the grappling-irons which lift it have to resist not merely the vertical component of the weight of the cable, but also the considerable effects resulting from friction against the water. It thus frequently happens, when working at great depths, that the conductor may be exposed to a strain greater than it is able to bear, and we are forced to have recourse to stratagems to bring it to the surface. These artifices consist in the use of two or more ships in raising, which is done as shown in figs. 2 and 3, or, in the most simple cases,

[1] Reproduced in abridged form from the *Electrical review*, and the cuts from *La lumière électrique*.

e aid of an auxiliary buoy, as in fig. 4. In nt, we see that the difficulties, and of course of raising, must be considerable.

e to decrease the weight of the cables would mportant step in advance. If the weight is ral very great, it is because the copper core t take any part in the strain which the entire as to resist. We know, indeed, that copper bear a breaking-strain greater, at most, than per square millimetre. Besides, it would be

FIG. 1.

ed by such a strain by a very considerable of its initial length; and, if the core were take part in any manner whatever in the which the entire cable has to support, it be drawn out beyond its limit of elasticity, uld remain permanently elongated, whilst the ces in which it is enclosed would return to tural length. It would result, that, being no able to find room in a sheath which had be- o short, the copper wire would take a sinuous its gutta-percha envelope, and would occasion in points ruptures, the effect of which would ecentralize the wire, to perforate the layer of ing matter, and finally to open out a fault in le.

here exists an alloy (silicium bronze) which drawn out into wires having a conductivity that of copper, and a mechanical resistance that of the best iron. The use of this alloy ender it possible to set free the coating of the

FIG. 2.

rom a part of the strain which it now has to and to diminish, consequently, their dimen- d weight. Wires are now made of this alloy, a conductivity of from ninety-seven to ninety- r cent of the standard, which at 0° C., and e diameter of a millimetre, have a resistance ohms per kilometre. These wires do not ith a less strain than from 45 to 48 kilos. per square millimetre, and, which is a very precious property, their increase in length at the moment of rupture does not exceed one or one and a half per cent.

Let us consider the deep-sea section of cable of the French company from Paris to New York, — the so-called 'Pouyer-Quertier' cable, constructed and laid in 1879 by Siemens Brothers of London.

The respective weight of each of its component elements is, per nautical mile, copper core, 220 kilos.;

FIG. 3.

gutta-percha, 180 kilos.; hemp, or an equivalent, 80 kilos.; 18 wires of galvanized iron of 2 millimetres in diameter, 860 kilos.; external hemp and composition, 400 kilos.: total, 1,740 kilos. Total diameter, 30 millimetres. Total mechanical strength, 3,000 kilos., the wires of the covering being supposed to be of iron. Weight under water, 450 kilos. It can support its own weight without breaking for a length of from six to seven miles.

The Atlantic presents from north to south, and at about an equal distance from each continent, a sort of longitudinal ridge, in which the depths vary from 300 to 400 metres. This ridge spreads out, in 50° north latitude, into the region which has received the principal wires connecting England and France with the United States. On both coasts there are depressions in which the bottom is at the depth of from 4,000 to 6,000 metres. The one on the east extends from the south point of Ireland to the latitude of the Cape of Good Hope, and its left-hand

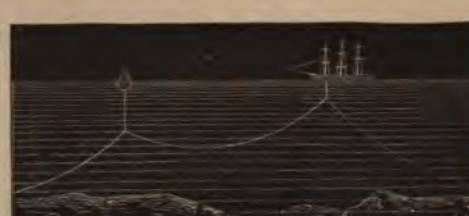


FIG. 4.

boundary follows the general outlines of the west coasts of Europe and Africa. The two others, the north-western and the south-western, form two basins, bordering respectively on the United States and the Antilles and South America.

In these depressions soundings have shown certain zones in which the depths exceed 6,000 metres, the principal of which are found to the west of the Cana-

ries, to the south of Newfoundland, between Porto Rico and the Bermudas, and to the right of the Isle of Marten-Vaz.

The great depths of the Pacific are differently distributed. Between Japan and California, between 40° and 50° north latitude, there is the Tuscarora depression, which has depths of from 6,000 to 8,000 metres. Parallel to Japan and the Kuriles there is a depression in which has been found the greatest known depth, — 8,513 metres.

We see, therefore, that any new great submarine line, having to extend into another zone than that which has received the present Atlantic cables, must traverse depressions in which the bottom reaches a maximum depth of 4,000 metres. The possibility of raising a damaged cable would be very problematical under such conditions, and it would become certainly impossible in case of a cable from San Francisco to Japan.

Under these conditions, we are forced to conclude that the use of the present cables limits strikingly the progress of submarine telegraphy, which must remain confined to certain zones of the Atlantic, to inland seas, and to lines along the coasts. But if we consider the daily progress of applied science, and the constantly increasing demand for rapid communication between nations, it is certain that we must shortly undertake the study of new cables intended to traverse the greatest depths of the ocean for long distances. Necessity, therefore, compels us to investigate the new solutions of the problem, which may furnish us with light cables, easy to lay, and possible to repair.

A cable made by Mr. J. Richard is composed as follows: core of silicium bronze equal in weight to that of the 'Pouyer-Quertier' cable, or, per nautical mile, 220 kilos.; gutta-percha, 180 kilos.; layer of hemp, 80 kilos. The sheathing is formed of 28 wires of galvanized iron of 1.25 millimetres in diameter, each covered with hemp, and all twisted into a rope around the dielectric; the wires, 500 kilos.; the hemp covering them, 250 kilos. The weight of the cable is, therefore, 1,230 kilos. in the air, and 320 kilos. in the water. Its diameter is 25 centimetres, and its resistance to fracture, 2,800 kilos., of which the core supports one-half. Under these conditions, the cable can support from eight to nine nautical miles of its length, and can be raised from the greatest depths. The results of this comparative examination are self-evident.

For an equal conductivity and an approximately equal mechanical strength, the new cable is in weight and bulk equal to about two-thirds of the Pouyer-Quertier cable. It would cost about $165 less per mile, and would require, for laying, a ship and engines of less power, and therefore cheaper. The reduced armature will suffice to resist friction and the attacks of animal life in the deep sea; but for the shore ends we must keep to the types generally employed. Such as it is, and although it may undergo modifications in detail from a more complete study and from experience, it merits the attention of competent engineers.

THE AMERICAN PUBLIC HEALTH ASSOCIATION.

The twelfth annual meeting of this association, held at St. Louis from Oct. 14 to Oct. 17, was one of the most successful in the series. The number of members present was large; and it is a matter of great promise for the association, that state and municipal boards of health were more fully represented than at any previous meeting.

These occasions have a value far beyond the intrinsic merit of the papers presented. The discussions are always instructive, often valuable. The sanitary questions of municipal life vary essentially in the different cities of the Union, and are answered in as many ways; and every public-health officer will find something to learn, as well as instruction to give.

Several threadbare topics, which have occupied the attention of this body for years, have disappeared from the programme, such as vaccination, yellow-fever, and malaria.

The order of exercises, as arranged by the executive committee, included the following subjects: Hygiene of occupations, Hygiene of the habitations of the poor, School hygiene, Adulteration of food, Water-pollution, Disposal of sewage by chemical action or irrigation, The observable effects upon the public health of official sanitary supervision, The work of state and municipal boards of health, Disease-germs, Cremation as a sanitary measure in times of great epidemics, Survey of present sanitary situation in St. Louis.

Nearly forty papers upon these topics were submitted. By far the larger number were of more than average merit, giving rise to interesting and instructive debate. The following-named papers contained more, perhaps, than the others upon the newer subjects in sanitary work.

Dr. Sternberg's paper upon disease-germs, read at the evening meeting of the third day, attracted the largest audience of the convention. This paper, which was illustrated by a collection of remarkably good microphotographs projected upon a screen, was substantially a re-statement of observations already made, and fortified by additional research. His statement that he was still at work upon the study of yellow-fever, by means of an abundant material furnished him from Havana, is a source of much satisfaction, somewhat diminished by the fact that this indefatigable and competent investigator carries on his work at his own expense. How long will the people of this country be willing to accept from the well-appointed laboratories of the old world the researches of Koch, Pasteur, and Klein, — investigations into diseases of as much importance to one side of the Atlantic as to the other, — and still hesitate to properly study the one disease peculiar to our own continent — yellow-fever?

Dr. Sternberg's assertion that he has demonstrated the non-existence of a yellow-fever germ in the blood cannot be strictly accurate. At this day one cannot exclude the possibility of making visible, by some at present unknown methods, organisms not yet recog-

nized. His own belief as to yellow-fever appears to be, that the habitat of the possible germ is in the digestive tract, as in cholera.

Professor Vaughan's paper on poisonous cheese treated a subject that has for a long time been under investigation, with no very satisfactory result. He has not been able to isolate the poison, which appears to be soluble in alcohol, but found it to be constantly associated with a very decided acid reaction of the cheese. In this view of the case, we have, then, a test of easy application in any hand.

Dr. B. F. Davenport, inspector of drugs for the State board of health, lunacy, and charity, of Massachusetts, and milk-inspector of Boston, read a paper descriptive of the work done in his laboratory, which, with the work of the state inspectors and analysts, has produced a very marked improvement in the milk-supply of Massachusetts.

Surgeon C. Smart, U.S.A., in a paper upon water-analysis, present and future, called attention to the necessary limitations of a merely chemical analysis of water. The determination of the amount of organic matter is, after all, not of definite value, unless the living organisms that may furnish it can be shown to be innocuous.

Dr. F. R. Fry of St. Louis presented the results of an examination into the artificial mineral waters of St. Louis, notably soda-water, which appears to be generally made with water from polluted wells. This is the danger that also attends the watering of milk. The loss in nutriment is often of far less consequence than the polluted water of the barnyard or other source used.

A paper upon cremation as a safeguard against epidemics, by Rev. G. A. Beugless of Brooklyn, and another by Hon. G. M. Keating of Memphis, on sanitation by fire, were the occasion for the appointment of a special committee to consider the whole subject of the disposal of the dead.

Three conferences of representatives of twenty state boards of health were held during the same week. At these meetings a representative of the Dominion of Canada, and one from the Province of Ontario, were present. This assembly was one of unusual importance, since, in the absence of an effective national organization, the country must look to these bodies for any concerted action in case of the appearence of cholera in this country.

Dr. Rauch of Illinois brought before the conference a carefully prepared statement of his views upon the value of a proper quarantine, and the claims of the states to a protection at the hands of the national government, and, failing this, the obligation to protect their own borders from invasion by contagious disease. His own experience had taught him that cholera in this country had invariably accompanied the infected person, and the person alone, generally an emigrant, surrounded by all the depressing conditions of his journey. He regarded the disinfection of rags, baggage, etc., as of minor importance. He concluded by urging upon congress the rehabilitation of the National board of health, or the formation of some stronger and more largely representative substitute, with power and funds sufficient to maintain a sanitary quarantine on the seaboard, and official inspection of the lines of travel by river and rail in the interior, and to assist states and municipalities in their efforts to prevent the introduction of disease, or to remove it when introduced.

Dr. Chancellor of Maryland presented his views, differing apparently very widely from those brought forward by Dr. Rauch. He did not accept the contagiousness of cholera; did not believe in the value of quarantine, which was always attended by the danger that a false sense of security was engendered, and other necessary sanitary precautions were neglected.

Dr. Holt, chairman of the Board of health of Louisiana, urged a quarantine in the newer and better sense of the word, — a detention of passengers and ships long enough to secure thorough inspection and disinfection; the shorter the period, the better.

A committee of five, consisting of Drs. Baker of Michigan, Walcott of Massachusetts, Herrick of Louisiana, Rauch of Illinois, and Bryce of Ontario, to whom were referred all the papers read, reported certain recommendations which were adopted by the conference, receiving the votes of all the states except Minnesota; she voting 'no' by reason of insufficient time to consider so important a subject.

The main points of this report are the following: —

That the factors essential to the disease are, —

1°. The importation of the disease by ships more or less directly from its only place of origin, in the delta of the Ganges.

2°. Local unsanitary conditions favorable to the reception and development of the disease.

3°. Persons sick with the disease, or things infected by such sick persons.

In view of the possible and probable introduction of cholera in the coming year, and the constant danger from other communicable diseases at foreign ports, it was the sense of the committee that the national government should maintain a national health service which should establish an effective system of quarantine, the appointment of medical officers at foreign infected ports, the prevention of the landing of immigrants until the danger of the introduction of cholera by them shall have passed.

The inspection and quarantine service originally devised by the National board was approved. It was recommended that congress be urged to appropriate five hundred thousand dollars, to be used, the whole or as much as necessary, in case of cholera, for the purpose of removing the disease and of preventing its spread from state to state. A vigorous prosecution of the work of local preparation, by cleaning foul localities and removing unsanitary conditions in anticipation of disease, was insisted upon. The concluding sentences of the report are, —

"The cause of cholera is contained in the discharges of persons affected by the disease or in things infected by such discharges. Should the [illegible] ase reach this country, the first case, and aft by fo s the first ca dise which reaches any given comm hould be str er thi ly isolated. All infective ma was from these nity, the la terial

from any subsequent cases should be destroyed in such manner as to stamp out the disease."

The conference adjourned, to meet in Washington on the second Tuesday of December.

EUCLID AS A TEXT-BOOK OF GEOMETRY.

ALTHOUGH Euclid has long since been superseded in the schools of this country, the following statistical notes on the extent to which Euclid's 'Elements' are still used in other countries may prove of some interest to the readers of *Science*. The figures are derived from a list of editions of Euclid's 'Elements' and 'Data' up to the year 1879, contained in a new Russian school edition of the 'Elements' by Professor Váshchenko-Zakhàrchenko.[1] This is a noteworthy work in several other respects. Besides numerous and extensive notes, and additions to the text, designed to render Euclid's treatment of geometry more palatable to modern taste, and to fill up some lacunae in the old work, the author has prefixed to his translation a valuable dissertation on the axioms and postulates and on the so-called non-Euclidean geometry of Bolyai and Lobachéfsky, of which a sufficiently full sketch is presented. That a man so well acquainted with modern investigations of the principles of the science of space as Mr. Vàshchenko-Zakhàrchenko (a bibliography of this subject is also appended to the volume) should prove such an ardent adherent of Euclid, pure and simple, for the schools, is a truly remarkable fact. A closer inspection of his own list of editions of Euclid might have shown him that the modern mind does not tend at all in the direction of a revival of Euclid's system and methods in geometry.

This list has 455 entries, of which 2 belong to the fifteenth, 84 to the sixteenth, 92 to the seventeenth, 118 to the eighteenth, and 159 to the nineteenth century. This enumeration includes reprints. Of really different editions there were, according to the author's count, 80 in the sixteenth, 59 in the seventeenth, 50 in the eighteenth, and 115 in the nineteenth century.

Mr. Vàshchenko-Zakhàrchenko, however, does not pretend that his list is complete: indeed, he has not attempted to present a full and correct bibliography of all editions of Euclid. The titles are given in such an abridged form as to make identification in some cases difficult; and typographical errors abound. No American edition appears in Mr. Zakhàrchenko's list, although several have been published in the United States.[2] Still, for our purpose the list, as it is, will yield some interesting results. We have only to group its data so as to show the distribution of the various editions among different nations and by centuries. This is done in the following table:—

PERIOD.	Greek and Latin.	English.	German.	French.	Italian.	Dutch.	Spanish.	Swedish.	Russian.	Polish.	Danish.	Portuguese.	Modern Greek.	Finnish.	Arabian.	Chinese.	Total.
15th century .	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
16th " . .	60	1	2	4	12	-	2	-	-	-	-	-	-	-	3	-	84
17th " . .	43	3	9	16	10	7	2	-	-	-	-	-	-	-	1	1	92
18th " . .	31	26	17	18	11	5	3	3	3	-	-	1	-	-	-	-	118
1800 to 1839 . .	9	15	21	1	1	-	-	1	2	2	1	-	1	-	2	-	56
1840 to 1879 . .	0	95	1	-	3	-	-	2	-	-	-	-	-	1	-	1	103
Total . . .	145	140	50	39	37	12	7	6	5	2	1	1	1	1	6	2	455

There can be only one interpretation of these figures. They illustrate in a striking way the fact that at present Euclid is used as a text-book in the schools in no country but England.

The English editions constitute thirty-one per cent of the whole number in the list, and fifty-three per cent of those in the four principal living languages (English, French, German, Italian). But this disproportion only appears in its full significance when we take into account the time of publication. Indeed, the table shows that up to 1840 the number of editions in the above-mentioned four languages is almost the same, — viz., 45 in English, 39 in French, 49 in German, 34 in Italian, — while, within the last forty years, 95 English editions have appeared, but only 1 German, 0 French, and 3 Italian editions.

In France the yoke of Euclid was thrown off as early as the end of the last century. The last French school edition of Euclid, according to Mr. Zakhàrchenko's list, was published in 1778. Thus, in France the end of Euclid's reign coincides with the beginning of the epoch of greatest splendor in the history of mathematical research; and, indeed, it is well known that this change is directly due to the influence of that celebrated school of French geometers who gave such lustre to the latter part of the eighteenth century, and won for France her unrivalled supremacy in mathematical science during this period. Legendre's 'Elements' took the place of Euclid's, until he, in his turn, had to yield to more modern influences. And as early as 1814, Delambre and Prony, in their report on Peyrard's critical trilingual edition of the 'Elements' and 'Data,' were justified in speaking of Euclid's method as 'une manière passée de mode,' and of his style as 'aujourd'hui peu connu.'

Italy, Spain, Russia, and other countries, soon followed suit. Everywhere the influence of the French school was felt; and, until the last quarter of a century, Legendre supplanted Euclid, when in many of these countries there arose schools of geometers who independently provided their countries with excellent text-books of their own. In Germany, Euclid held his own longer than anywhere else. But, on the other hand, opposition to the old system is nowhere so universal and uncompromising now; and nowhere has modern geometry found so many enthusiastic disciples.

A. ZIWET.

[1] "The Elements of Euclid, with an explanatory introduction and annotations, by M. E. Vàshchenko-Zakhàrchenko. Kieff, 1880." 15 + 747 pp.

[2] The library of congress possesses two American reprints of R. Simson's Euclid [illegible]ished by Desilver of Philadelphia in 1825 and 1834 resp[illegible], and an addition of the first three books of the 'Eleme[illegible] [illegible]layfair's text), with notes, under the title "The geometry [illegible]clid: with annotations by Horatio Hubbell, Phila., J. B[illegible]cott & Co., 1861."

'T-SINKING BY FREEZING.

hod of shaft-sinking recently invented by Poetsch of Aschersleben, by means of the oduction of low temperatures, is an illus- the new and unexpected directions in nical and physical processes become of inking shafts for mining and other engi- rposes, and in the construction of deep , the presence of quicksand has always ed; for it can be penetrated, if at all, only difficulty and expense. While the use of air has enabled us to sink shafts and place s in water-bearing strata, we are limited not much exceeding one hundred feet by al inability of the human system to en- r air-pressures. Mr. Poetsch has success- d to such cases a method of shaft-sinking , which bids fair to remove all the trouble. s to do away with the pumps and air- , to transform the surrounding liquid soil wall of ice, and in this way to reduce the shaft-sinking to that of work in hard, dry

of tubes is sunk around and within the proposed shaft, and a saline solution such of calcium, of very low temperature, its freezing-point — 40° F., and passed Carré ice-machine, is caused to circulate e system by means of inner tubes until uid soil is solidified by congelation. The e of the ground has been reduced, in actu- om 52° F. to 0° F. in twenty days, freez- a circle of about five feet diameter around and producing in the quicksand the solidi- stone, with all its properties of stability, hoidal fracture.

hod of putting in place the freezing-pipes the locality. When the quicksand has a kness only, and the shaft is already sunk er-level, the pipes are simply forced into ith a sand-pump working inside. This was actually employed at the Archibald mine, eidlingen, Prussia, where twenty-three ly eight inches in diameter were sunk water-bearing stratum eighteen feet thick, Max mine, near Michalkowitz, Upper Si- ther cases a boring-machine is used which four pipes at a time, and is worked by the ystem. If the fluid soil lies at no great holes for the pipes are bored from the sur- e pipes are so arranged that the shaft can side of them; but, when the water-stra- great depth below the surface, a shaft of feet greater diameter than the finished t sunk through the firm ground, so as to he sinking of the pipes through the fluid d the construction of the final shaft within

Centrum mine, near Berlin, one hundred feet of quicksand had to be penetrated. had been baffled for years in their attempts e the difficulties. In thirty-three days, with sixteen pipes, Mr. Poetsch had secured a wall of ice six feet thick around the shaft area, and the shaft is now being excavated and curbed without special difficulty.

A series of bridge-piers is to be sunk by this method near Bucharest, Austria. This last contract has especial interest; as it will afford a test of the seemingly just claim of the inventor, that his plan opens up great possibilities in founding bridge-piers. As opposed to the compressed-air process, the main advantages are in the practical absence of limitation in depth, and the relief of the laborers from the effects of severe air-pressures. The entire plant can be used repeatedly, as the pipes can be withdrawn as soon as the ground thaws out. The cost of an undertaking can also be estimated in advance with reasonable certainty.

A more detailed description of this process is given in the *Engineering news*, June 7, 1884, based on an article from the *Zeitschrift für berg., hutten., und salinenwesen in Preussischen staate*, and in the *Engineering news*, July 5, 1884, with illustrations of the plant used at the Centrum mine.

CHAS. E. GREENE.

AMERICAN ORIENTAL SOCIETY.

THE American oriental society held its autumn meeting at the Johns Hopkins university in Baltimore on Wednesday and Thursday, Oct. 29 and 30. A grammar of the Siamese language was reported as nearly finished by one of the members, Rev. S. C. George. A vocabulary of the Mortlock dialect had been offered to the society for publication by a missionary in the Caroline Islands, and a translation of the Prem Sagar from the original Hindi by the Rev. J. M. Jamieson. The Peking missionary association sent resolutions respecting the eminent Sinologue, Dr. S. W. Williams, the lately deceased president of the Oriental society.

Fourteen papers were presented to the society. The extreme east was represented by a paper on the Korean numerals and alphabet. Mr. Rockhill, an *attaché* of the U. S. embassy to China, presented to the library a Tibetan book of poems by Milaraspa, a Buddhist missionary of the eleventh century; and his paper gave an account of the work, with specimen translations. The president of the society, Professor Whitney of Yale, discussed a group of aorist-forms in Sanscrit. The forms in question are of especial interest, inasmuch as they furnish a good test-case for the general trustworthiness of the Hindu science of grammar, as compared with the most modern treatment of the subject. Professor Bloomfield of Johns Hopkins discussed the position of the Vaitana sutra in the literature of the Atharva-veda, an important text of which, the Kauçika sutra, he is now editing. Several Syriac and Hebrew papers of value were presented; but we must pass them by for want of sufficient space.

In Assyriology, finally, there was an account by Professor Lyon of Harvard, of the last instalment of

the cuneiform inscriptions of western Asia. This contains a great deal of linguistic and historical material; e.g., a list of four hundred and eighty Assyrian verbs so arranged as to show an aquaintance with an *alphabet* on the part of the writer. We find, first, a series of groups of verbs whose first and second consonants are the same; and, secondly, within these groups, they are arranged according to their final consonant. This is the first inscription showing alphabetic order, and the alphabet is substantially the same as the Hebrew. Unfortunately the tablet is not dated. There is also an historical tablet of Nabunaid or Nabonetus, who was king when Cyrus took Babylon. Nabunaid tells how he restored the temple of the sun-god, and states that in renewing the foundations he discovered an old inscribed tablet that had been placed there by Naram-Sin, thirty-two hundred years before his own day, i.e., about 3750 B.C. The interest in archeology, therefore, is itself something very ancient.

TAIT'S LIGHT.

Light. By P. G. TAIT. Edinburgh, *Adam and Charles Black*, 1884. 8+276 p. 8°.

THIS book, uniform with 'Heat' by the same author, possesses in an eminent degree the qualities which render all books from Professor Tait eagerly welcomed by students of physical science. Although written primarily for the use of university students, it contains much which would interest and instruct one who has never pursued a definite course of study in physics, while there is not a little which will demand close attention from even a well-equipped student.

The first chapter gives a brief but perspicuous historical sketch of the discoveries in the science of light, down to the work of Alhazen. This is followed by chapters on the sources of light, and an admirable treatment of the consequences of the rectilinear propagation of light-waves. Chapter vi. treats of the speed of light. Chapters vii. to x. inclusive are devoted to the phenomena of reflection and refraction. Of notable excellence in the last of these, is the discussion of the rainbow and halos.

The eleventh chapter, doubtless, contains most that is novel to the general reader; for in it is an explanation of refractions in a non-homogeneous medium, including as special cases the phenomena of mirage. For the solution of the most interesting problems presented by these frequently recurring phenomena, we are indebted to Professor Tait more than to any other investigator; and probably no other writer could give in such a simple form so clear a presentation of the subject. The last section of this chapter the author devotes to a eulogy on his master, Sir W. R. Hamilton, and an emphatic assertion of the necessity of extended mathematical study for the student of physics. This concluding paragraph is as important as it is characteristic in style, and may well be quoted. It reads as follows: —

"We have thought it absolutely necessary to point out, even in an elementary work like this, that such a perfectly general method [Hamilton's principle of varying action] has been developed; but the few fragmentary illustrations of it, which alone can be given without the use of higher mathematics, are so inadequate to the proper exhibition of its power, that we do not give them here. We have said enough to show that any one who wishes really to know the science as it now stands must previously prepare himself by properly extended mathematical study. When he is possessed of this indispensable instrument, he may boldly attack the precious stores of knowledge already accumulated. There is, as yet, no admission to any but those possessed of this master-key."

Fluorescence and absorption, with the attendant phenomenon of anomalous dispersion, form the subject-matter of chapter xii., which contains a highly interesting extract from a recent letter by Professor Stokes on the subject of fluorescence. The next chapter introduces the undulatory theory of light; the remainder of the book being a development of its consequences, including, in the final chapter (xvi.), radiation and spectrum analysis. An appendix contains, 1°, Hamilton on theories of light; 2°, Huygens on rays; and, 3°, the well-known and astonishing letter of Laplace to Young, on the undulatory theory. An index closes the volume.

Though the book is, perhaps, the most important acquisition to the literature of its class for a number of years, there is one particular in which we could have looked for something better. The theory of lenses given is the old one, which has hardly been improved since the time of Kepler, and which is repeated in all English elementary works on physics. By it the approximations are so very imperfect that they are next to useless in practice; while, by employing Gauss's improvements in the theory, formulas no more complicated in form, and hardly more difficult in derivation, could be given, which are of the greatest utility. It has long been the practice in German works, written for students no more advanced than those who will be the readers of this work, to give the Gaussian theory; and it is not easy to see why English writers should have been so slow in adopting it.

MAMMALS OF THE ADIRONDACKS.

mals of the Adirondack region, north-eastern York. By CLINTON HART MERRIAM, New York, *Foster pr.*, 1884. 10+316 p.

recent works on our native animals will ed with keener interest by the general han Dr. Merriam's 'Mammals of the ack region;' it being a popular narra-he habits of the mammals of the great ack wilderness, and 'in no sense,' as or states, 'a technical treatise.' Based wholly on original observation, in the e author's own, it differs widely from inary works on such subjects, every aring strong evidence of long-con-intelligently and patiently conducted rk.

egion under consideration occupies por-twelve counties, and has an area about dred and twenty miles square. It is of mountains and short ranges of high ich, conforming to no regular axis, con-regular groups of isolated peaks, nearly which attain a height of three thou-t, while five exceed five thousand. The s everywhere studded with beautiful vo of which are more than four thou-t above sea-level. The western border ea has an altitude of about a thousand e land rises thence eastwardly to its part, along the eastern border, where ation falls abruptly to the level of Lake three hundred and forty-three feet e sea. The region is mainly covered rgreen forests, composed very largely gle genus (Abies) of coniferous trees. g to the elevation and northern position, a of the Adirondacks is distinctly and purely 'Canadian.' Snow covers the for nearly half the year, with a mid-verage of over four feet in depth. Dur-season the temperature often falls to ., and sometimes to $-40°$ F.; while ons of forty, fifty, and sixty degrees eit are by no means uncommon,'' and a er seventy degrees in fifteen hours has erved.

its isolation, its almost unbroken and its peculiar topographic and cli-atures, no region of equal extent east Rocky Mountains, doubtless, offers so ractions to the naturalist.

erriam, in his 'General introduction,' ome sixteen pages to the topographic, floral, and faunal features of the region, and then treats in detail the forty-six species enumerated, in systematic order. Two of the species (harbor-seal and fox-squirrel) are given as accidental stragglers; and it is presumed that one or two shrews, and two or three bats, are still to be added to the list. The wolverine, moose, and elk are recorded as extirpated, the last moose having been killed about 1861, while the elk and the wolverine have not been seen there for nearly half a century.

Dr. Merriam writes, in the main, tersely and in good taste; although his impatience with popular fallacies leads him here and there to almost undue positiveness of expression, even though his position may be unassailable. His pages are replete with information gathered from personal observation and from trust-worthy hunters and guides, and show a famil-iarity with the region and its natural productions which only long experience could give. Par-ticularly noteworthy is his account of the pan-ther (Felis concolor), which, owing to the bounty placed upon it by the 'state' in 1871, is now approaching extirpation. Contrary to current opinion and the authority of respectable authors, this animal is represented as "one of the most cowardly of beasts, never attacking man unless wounded and cornered." The wolf, common twelve years ago, is now com-paratively rare, the special cause of the de-crease not being obvious.

Nineteen very interesting and entertaining pages are devoted to the skunk, — apparently a special favorite of our author, — in which a number of popular fallacies are exposed, among them the belief that the bite of the skunk is usually fatal through giving rise to a peculiar kind of hydrophobia, which has been named 'rabies mephitica.' Dr. Merriam claims that a bite from a healthy skunk is in no way dan-gerous, as he has found by personal experience, but that skunks, like other animals, are sub-ject to rabies, and, when thus afflicted, are of course dangerous.

There are thirty pages which relate to the common Virginia deer, the only existing ungulate of the region, in which the matter of 'spike-horn bucks' very naturally receives special attention. In 1869 a writer in the *American naturalist* stated that he had hunted deer in the Adirondacks for twenty-one years, but not till within the last fourteen years had he begun to hear of spike-horn bucks. "The stories about them multiplied, and they evi-dently became more and more common from year to year. . . . These spike-horn bucks are now [1869] frequently shot in all that portion

of the Adirondacks south of Raquette Lake." The spike-horn was described as differing greatly from the common antler of the species, it consisting of a single spike, more slender, and about half as long as the antler, projecting forward from the brow, and giving "a considerable advantage to its possessor over the common buck." In consequence of this advantage, the 'spike-horns' were said to be 'gaining upon the common bucks,' with the prospect that in time they might 'entirely supersede them in the Adirondacks.' The descendants of the original spike-horn — 'merely an accidental freak of nature' — are supposed by this writer to have propagated the peculiarity "in a constantly increasing ratio, till they are slowly crowding the antlered deer from the region they inhabit."

Although this view of the case was criticised by subsequent writers in the *Naturalist*, the original account attracted the attention of Mr. Darwin, who cites it, and generalizes from it in his 'Descent of man.' It has since been affirmed by high authorities that the 'spike-bucks' of the Adirondacks are all nothing more than yearling bucks with their first antlers.

Dr. Merriam scouts the idea (and we think with good reason) that the 'spike-bucks' (which have obtained no little celebrity, and been the basis of much speculation with somewhat visionary writers on evolution) are a distinct race of deer, and is able to cite but a single exception to the rule that 'spike-horn bucks are always yearlings,' — that of a maimed, very aged, ill-conditioned animal. This exception he views as an illustration of the tendency in extreme age for certain parts to revert to a condition resembling that of early life, and of the fact that ill-nourished bucks bear stunted and more or less imperfect antlers. All yearlings, however, do not have true spike-horns; and, if the term be made to include all unbranched antlers, Dr. Merriam inclines to the belief that two-year old bucks may sometimes grow them. The myth of the spike-horn, like many other myths in science, will doubtless still live [illegible] with the characteristic persistency of [illegible]s.

[illegible]'s observations respecting the [illegible] and the shrews, throw much [illegible] obscure ways of life, in con[illegible]s in a state of nature. His [illegible] rodents are also full of fresh [illegible] may be especially directed [illegible] the gray and red squirrels, [illegible] of diction than for their [illegible] vividness of portrayal.

THE MOSSES OF NORTH AMERICA.

Manual of the mosses of North America. By LEO LESQUEREUX and THOMAS P. JAMES. With six plates illustrating the genera. Boston, *S. E. Cassino & Co.*, 1884. 447 p. 8°.

THANKS to our sole surviving bryologist, the venerable Lesquereux, we have at length a comprehensive manual of North-American mosses. In connection, first with Sullivant until his death, and more recently with James, who devoted himself unweariedly to the necessary microscopical investigation up to the very day almost of his passing away, Mr. Lesquereux has for years been more or less actively engaged in this work, and now happily sees its completion. Those who have been attracted to this most interesting family of plants, but have been deterred from their study by the dearth of accessible books upon the subject, will here find their chief wants supplied. It throws open to our younger botanists a broad field, where much can be done, and needs to be done, and where enviable reputations may be won by patient, skilled, and judicious workers.

The history of our mosses begins with Dillenius, who had received about a score of species from John Bartram, *colonus curiosus* of Philadelphia, and from Mitchell and Clayton of Virginia, describing and figuring them in his 'Historia muscorum,' in 1741. Some others of Clayton's collection were described later by Gronovius, but only seven of these species were recognized as from America by Linné, in his works.[1] The first edition of Sullivant's 'Mosses of the United States' (originally published in the first edition of Gray's Manual, in 1848) included 205 species, of which 51 were exclusively American. In the second edition (1856) the number was increased to 402, the American species being 143. In the present work, with a wider range, there are described 883 species, 363 confined to North America, and 21 others found only in tropical America. Of these American species, one-half (180) were detected and described by our own Sullivant, Lesquereux, James, and Austin; the remainder by Europeans; there having been scarcely a bryologist, from Hedwig and Schwaegrichen to the present generation, that has not been concerned with them. A considerable number of these species have been made on scanty material

[1] One of these Linnean species is not referred to in the manual; viz., Phascum caulescens, based upon the 'Sphagnum foliis teneribus, graminis, pellucidis,' of Dillenius, which is Tetraplodon australis, Sulliv. and Lesq.; to which must now be added the needless synonyme, Tetraplodon caulescens, Lindberg.

[...]single locality, and are of questionable [...]. They have, however, to be recog[...] a work like this, and in the want of [...] evidence to exclude them; and it re[...]for future students to determine their [...]tus.

European authorities are here followed [...]rating the anomalous genera Sphagnum [...]ndreaea as distinct orders; while in [...]yaceae, or mosses proper, Schimper's [...]ment is in general adopted, with an [...]nal consolidation of his too numerous [...]and genera, — notably in the case of [...]us Hypnum, which, under twenty-eight [...]era, is made to include nearly a fourth [...]the species. By several artificial and [...]cal keys the student is aided in referring [...]nts to their proper tribes and genera, [...]aracters of which, as well as of the [...], are given with sufficient fulness and [...] The synonymy and citation of author[...]while not numerous, are such as to be [...]ice to the student capable of benefiting [...]m. The habitat and range within our [...]is given under each species, but not [...] with sufficient definiteness; and it is [...]that there is any indication that a species [...] exotic, except as it may be inferred [...]he citation of Bruch and Schimper's [...] in the 'Bryologia Europaea.' The [...]clature, too often a weak point with [...]gists, is, on the whole, to be commended [...]conformity with accepted rules, though [...] to criticism in some cases; as where [...]neric names, Ulota, Tetraphis, and [...]um, are retained in place of the earlier [...]a, Georgia, and Catharinea of Ehrhart. [...]ews of Mueller, Mitten, and Lindberg, [...]ot followed, are in many cases given in [...]onymy.

[...] publishers have made the book attractive [...]e, clear type and good paper. Many [...] doubtless have preferred a somewhat [...] type and thinner paper, by which the [...] the volume might have been reduced [...]t one-half. Publishers should remember [...]e convenience of a 'handbook' is in[...] as its size. S. W.

[...]EOLOGY OF SOUTH-EASTERN PENNSYLVANIA.

[...]présentées à la Faculté des sciences de Lille uni[...] de France pour obtenir le grade de docteur ès-[...]es naturelles. Par PERSIFOR FRAZER, [...] Lille, 1882. [6]+179 p., 4 pl. 4°.

[...] work is based upon the author's labors [...]ember of the second geological survey of Pennsylvania during the seven years from 1874 to 1881, being essentially a synopsis of his published reports (C^1, C^2, C^3, C^4) on Adams, York, Lancaster, and Chester counties. These counties, with the addition of Delaware and Philadelphia counties, which are geologically but an extension of Chester county, include all that part of Pennsylvania south of the belt of triassic sandstone, stretching from the Delaware to the Susquehanna, and east of South Mountain.

Professor Frazer recognizes, in the rocks of this limited area, representatives of the four principal divisions of geological time, — the cenozoic, mesozoic, paleozoic, and eozoic eras. The tertiary beds, however, are of no commercial or structural importance, being restricted to a few small isolated patches of marl and lignite. The mesozoic or secondary rocks are, of course, the triassic sandstones, shales, and trap, concerning the limits and age of which geologists are generally agreed. With these exceptions, this is essentially a región of crystalline rocks; and the interest of this memoir undoubtedly centres in the chronological disposition of these stratified crystallines made by our author, who evinces an appreciation of the difficulties attending any solution of this vexed problem in citing the singular fact that those sections of the United States which are the seats of the densest population and the oldest civilization are precisely those where the opinions of geologists concerning the age of the rocks present the greatest divergence.

These rocks, and their extension in other states of the Atlantic seaboard, have been the principal battle-ground of American geologists for the last forty years. In all regions the chief difficulties which they present are their structural complexity, and the general absence of organic remains. But to these we have added, in the district in question, a topography affording few reliable outcrops of the rocks. The Susquehanna forms a remarkable natural section of this region, crossing the strike of all the formations between the coal-measures and the fundamental gneiss. But even here the exposures are few and poor, although what is definitely known of the succession of the lower formations in Pennsylvania has been in great part derived from the study of the rocks along this river and the Schuylkill.

Our author regards these crystalline rocks as belonging largely to the older eozoic formations, and accepts Dr. Hunt's definitions of the Laurentian and Huronian systems, referring to the former the porphyritic and hornblendic

gneisses, with their accompanying coarse limestone and graphite; and, to the latter, a large part of the chlorite and mica schists, and serpentine, with associated limestone, steatite, and argillite, and chrome and nickel ores, east of the Susquehanna, and the felsitic, chloritic, epidotic, and quartzose rocks of the South Mountain.

The felsites are said to be distinctly interstratified with the other rocks named, and the theory of their igneous origin is vigorously combated. The position of the Huronian in this region is shown to be clearly above the Laurentian, and below the primal sandstone; but it is also allowed to fill this great gap, to the exclusion of the Montalban system, which Dr. Hunt has recognized here.

The Taconian system is not admitted to the Pennsylvania column; but the quartzite, schists, marble, argillite, and iron-ores claimed by its defenders are referred, as by the first survey, and by Lesley, Dana, etc., to the Cambrian. With the exception of the Scolithus, found in a small part of the so-called primal or Potsdam series, all these rocks are alike unfossiliferous. Lithologically and stratigraphically they present little resemblance to the primal, auroral, and matinal west of the great valley and in New York; and hence the confident reference of these semi-crystalline rocks to the horizons named seems to rest on a very slender basis of facts.

NOTES AND NEWS.

THE English astronomers continue their observations of the great red spot on the planet Jupiter with all the enthusiasm of past years; one observer, Mr. Stanley Williams, obtaining, as early as the morning of Sept. 20, a favorable sight of that part of the disk of Jupiter which should be occupied by the red spot. It was still a visible object, although, at the then unfavorable position of the planet, one of extreme difficulty and delicacy. Only a very occasional glimpse of it could be obtained at all, as a faint patch of no particular color or boundary, until after its transit of the central meridian, when the spot was once seen in its entirety, and with a distinct reddish tinge about it. The great hollow in the red south equatorial belt still remains visible, but it appears to have much diminished in plainness. Mr. Williams has also observed three equatorial white spots, one of which is probably identical with a well-known white spot which has been followed for many years. The red spot has also been re-observed by Mr. Denning.

— At the October meeting of the Natural science association of Staten Island, Mr. Davis exhibited a specimen of one of our green grasshoppers, Conocephalus dissimilis, which he had found without any head, and stridulating while perched upon a blade of grass. When touched by the finger, the insect did not close its wings tightly, as usual, but let them remain far apart. It had evidently not been long decapitated; for, when captured, the muscles in the thorax had their normal appearance. But gradually the tissues dried, and on the third day of its captivity it died without having stridulated again, though every means thought of was employed to induce it.

— Dr. David Gill, her majesty's astronomer at the Cape of Good Hope, will contribute the article on parallax for the forthcoming volume (xviii.) of the ninth edition of the Encyclopaedia Britannica.

— Dr. E. B. Tylor, in an address to the anthropological society of Washington a few weeks ago, in which he narrated some of his experiences among the Mohaves and Zuñis last summer, said the Mohave has the same abhorrence of parting with a lock of his hair that is shown by an Italian or a Spaniard. The Zuñi uses the same sound-producing piece of wood to warn the women away from certain rites attending the admission of youths to the privileges of manhood as is used for a like purpose both in Africa and Australia. The latter consists of a piece of wood attached to a thong, and well known in England as a 'bull-roar,' from the character of the noise it makes when whirled rapidly. The use of bark skirts by the Zuñi women, who now wear a part of them under their joined red handkerchief robes, is paralleled by that of the Australian females. The Zuñis wore these originally in two parts, — one in front, and the other at the back, — forming, when both in place, a complete covering for the lower part of the body. Now that cotton-cloth is procurable, they make a skirt of bright-colored handkerchiefs sewed together, and wear this outside the bark garment, only the rear half or bustle of which they wear. The Australian women preserve the ancient custom by putting on bark skirts on festival occasions. Both customs show a tendency to survival, and a corresponding mode of perpetuating an ancient usage.

— A correspondent of the *Science monthly* writes that for the last year he has been engaged in the herring-fishery on the Kintyre coast, and has often been surprised during the night to hear a strange chirping-sound, like the far-away disconsolate 'chirp' of some small dying bird. "It was something in the air, and always portended southerly winds and foul weather, and was known everywhere as the 'Cheep-ach,'" was all the explanation that his mates had to offer. It is most frequently heard from the beginning of August till the end of November, and is never heard before sunset or after sunrise, but always during the darkness of night. It is never heard ashore, but often enough within two or three hundred yards of it. It is generally heard whilst sailing, but sometimes, though rarely, while lying at anchor. It is always accompanied by a dampness in the atmosphere, though never with rain, so far as he remembers. The sound is so very like the chirp of a bird that superstitious fishermen attribute it to the ghosts of little birds that have blown to sea and drowned.

rofessor James Hall has been elected member French academy in the place of the late Dr. J. nce Smith.

he experiments on the relative efficiency of nt illuminants for lighthouse purposes, which ing carried out in England by the Trinity en, have in some respects been completed; and upport the conclusions previously arrived at, there seems to be little difference between gas raffine-oil for all practical purposes, except that slight is slightly superior in fine weather, but he electric light has proved vastly better than The crucial test of the latter, however, is in eather; and it is stated, that, in some of the ations made when the weather was rather this light did not hold its own against the other nants. Important tests will be made this n, when hazy weather, and a greater variety in nditions of the atmosphere, may be expected.

well-equipped expedition to East Africa will dertaken by Dr. Dominik von Hardeggar in tumn. The first object of the expedition will explore the stretch of country between Sela arar, then that town itself and its neighbor- Lastly, if the circumstances are favorable, penetrate the land of the Somali to Ogaden, through to Schoa. The geographical and eth- hical studies of the expedition will be under- by Professor Paulitschke; the geological and ical, by Dr. von Hardeggar himself. A physi- nd assistant naturalist will accompany the

he university of Freiburg, in Saxony, is to have titute of zoölogy, Professor Weismann having it a condition of his remaining there.

he seventh general congress of German analyt- emists was held this year at Munich on the 9th gust, and the work of the honorary committee ued. The resolutions passed mostly referred restrictions of the German laws.

t a recent meeting of the Physiological society lin, Professor Kronecker spoke of a series of tionary measures to be observed in cases of life by an infusion of common salt solution. st described how animals, after severe loss of recovered in the best and most rapid manner roducing into their blood-channels a like quan- common salt solution. In the case of infu- of albuminous solutions, of serum sanguinis, ven of the blood of another individual of the pecies deprived of its fibrine, there was, accord- direct measurements, an invariable destruc- blood-corpuscles. With infusions of common olution, on the other hand, blood-corpuscles een to increase somewhat rapidly. Professor cker then proceeded more particularly to lay precautionary rules to be observed in applying ency to man. In the first place, the compo- of the solution must be such as was most com- with the human organism. It would appear solution of 0.73 % exercised the least irrita- the human body, and was therefore the most appropriate for infusions designed to save life. The addition of the carbonate of an alkali, recommended by some, had an injurious effect. Of great importance were the velocity and pressure with which the infusion was injected: both ought to correspond with the velocity and pressure in the vein into which the solution entered. The common salt solution should, further, be disinfected beforehand by boiling, and the air which penetrated into the reservoir while it was being emptied must be filtered by means of a wadding stopper. The injurious effect of too strong pressure was illustrated by a comparative experiment on two rabbits.

—The reduction in letter-postage from three to two cents commenced on Oct. 1, 1883. It is interesting to note the effects of this reduction on the postal business of the country as deduced from the returns for the year ending June 31, 1884. During the first three months of the year the three-cent rate was in effect, and the sale of stamps was much reduced in anticipation of the reduced rate. The increase in the sale of ordinary postage-stamps for the five years ended June 31, 1883, was 10.1 %; for the year 1883 the increase was 8.6 %. It is probable, that, owing to the general stagnation in business industries, the increase would have been less than 8 % in 1884 but for the reduction of postage. There was, however, an actual increase of 21 % in the number of 'ordinary postage-stamps' sold, or from 1,202,743,000 to 1,459,768,000, — an increase of 12.4 % over the year 1883, and of 11 % over the average increase for five years. The revenue from the sale of these stamps was $30,307,000 in 1883, $29,077,444 in 1884, — a diminution of $1,230,000, or 4 %. The issue of postal-cards has heretofore increased more rapidly than that of letters, or at the rate of 13.7 % a year on the average for the five years mentioned. During the last year the number diminished 4.4 %, or from 379,000,000 to 362,000,000. In the natural growth of the business, the postal revenue for the next year will probably be greater under the low rate than it has ever been under the high rate.

—Mr. Maxim, the electrician, has invented a machine-gun by which the energy of the recoil from one discharge is employed to load and fire the next round. The rate of firing is controlled by a lever; and, when the gun is once adjusted to a certain desired speed, it goes on firing at that rate until all the ammunition in the magazine is exhausted, whether the man in charge be killed or not. The maximum rate of firing, when the bullets have an initial velocity of twelve hundred feet per second, is six hundred rounds per minute.

—The U. S. signal-service is about to undertake the publication of a general bibliography of meteorology and allied topics (such as earthquakes, terrestrial magnetism, and meteors), and requests from the writers of all countries a complete list of their contributions to the literature of these subjects, including the titles of all separate works, papers, and published observations. The number of titles already on hand is about thirty-five thousand. Especial attention is invited to the importance of full titles,

with details of size, and place and date of publication. References to periodicals should be on this pattern: —

"Quetelet, Lambert Adolphe Jacques,
Sur les orages du mois d'Avril, 1865.
Bruxelles, Acad. Sci. Bull., XIX., 1865, 535-537."

Correspondence should be addressed to the chief signal-officer U. S. army, Washington.

— When the physical studies of the Gulf of Mexico and the Caribbean Sea, now prosecuted by the U. S. coast-survey, are brought to an end, and when our knowledge of the natural history of these waters is sufficiently increased, we shall hope to see a monographic description of them, after the pattern of Ackermann's admirable 'Beiträge zur physischen geographie der Ostsee' (Hamburg, Meissner, 1883). The arrangement of subjects is logical and systematic, and lacks but one chapter of being complete, for geological structure alone is not discussed. The first division of the book considers the form of the shores and bottom, under the heading of morphology, illustrated by bathymetric charts of fine execution; then, omitting the origin of this form, recent geological action along the shores, and the evidences of secular elevation and depression, are discussed. The physical relations of the sea are described under currents, winds and their effects, and the distribution of temperature; and the chapter on biology opens with a general discussion of the causes that influence the occurrence of marine life, followed by an account of the horizontal and vertical distribution of the fauna and flora, and concluding with the effect of the Baltic on the habitat of certain birds. The inward and outward flowing currents at the wider entrance to the sea are described in detail, and the tide is traced till it disappears with a height of only one centimetre at Memel.

— The geographical society at Halle has published a valuable local bibliography of physical and historical writings ('Die landeskundliche litteratur für Nordthüringen, den Harz,' etc., Halle, 1883), covering 170 pages, clearly arranged on a well-considered plan. It begins with natural-history topics (such as geology, hydrology, climate, fauna and flora), next taking questions that refer to population (such as anthropology, statistics, economics, and folk-lore), and ending with papers of special or historical interest; all of this being arranged, first for larger, and then for smaller, geographic areas. Maps of all kinds are included in the lists, and a good index to the various subdivisions allows easy reference to any subject or place.

— Scudder's 'History of the United States' (Philadelphia, J. H. Butter) belongs to the class of manuals which includes the histories by S. Eliot, T. W. Higginson, A. Gilman, and others; but our limits will not permit us to point out how it differs from them. Its typography is attractive; and it is a marvel that so many maps, portraits, and other engravings, can be given in a volume which is sold at so low a price. Among some of the novel illustrations may be named a map of the physical features of the United States, not entirely satisfactory; a map of the discoveries on the Atlantic seaboard in the fifteenth century; the progress of population westward in the United States; the sectional weather divisions employed by the U.S. signal-service; the standard-time belts; and a very large number of diagram-maps, most of which are admirable, inserted in the text to explain the wars, battles, progress of civilization, etc. The text is clear, readable, and concise.

— The fifteenth report of the Massachusetts bureau of statistics and labor, by Carroll D. Wright, contains an interesting paper on the condition of the working-girls in Boston; and this is followed by an elaborate study of the comparative wages, prices, and cost of living, in Massachusetts and Great Britain in the period between 1860 and 1883. As to wages, Mr. Wright's result is as follows: that the general average weekly wage of the employees in the industries considered in Massachusetts was 77 + % higher than the general average weekly wage of the employees in the industries considered in Great Britain. As to cost of living, it appears, that, on any basis of yearly expenditure, the prices of articles entering into the cost of living were, on the average, 17.29% higher in Massachusetts in 1883 than in Great Britain; that, of this figure, 11.49% was due to higher rents in Massachusetts, leaving 5.80% as indicative of the higher cost of living in Massachusetts as compared with Great Britain, as regards the remaining elements of expense.

— The American academy of medicine held its annual convention in Baltimore, Oct. 28-29, with Dr. Benjamin Lee of Philadelphia as president. None but medical men who have had a liberal collegiate education are eligible for membership in this association, which, among other things, endeavors to promote reforms and improvements in medical education.

— The Association for the advancement of women also held its annual meeting in Baltimore, Oct. 29, 30, and 31, under the presiding guidance of Mrs. Julia Ward Howe.

— The excellent 'Monthly reference-lists,' which are printed by Mr. W. E. Foster of the Providence public library, should be watched by scientific men as well as by literary readers. The August number (vol. iv. No. 8) contains a handy index to articles on earthquakes, theories and observations, which was suggested by the shock of Aug. 10, 1884. In judging of the list of memoirs and articles which are cited, the reader should remember that it is prepared for popular reading, and not as an index for the seismologist, or even for the physicist. The second part of the same number is devoted to the early English explorations of America.

— The portrait accompanying our account of Sir William Thomson was engraved from a photograph taken in Canada. Sir William has since sat for a photograph in Baltimore, copies of which can be had on application to Cummins, photographer, 7 North Charles Street, Baltimore.

— Ensign E. E. Hayden of the U. S. navy has been ordered to duty at the Harvard observatory.

SCIENCE.

FRIDAY, NOVEMBER 14, 1884.

COMMENT AND CRITICISM.

THE CUSTOM-HOUSE at Philadelphia and the Treasury department at Washington are wrestling over a difficulty growing out of the special tariff upon 'philosophical instruments.' Such instruments are, under the law of 1883, subject to a duty of thirty-five per cent, while instruments of glass or metal, not 'philosophical,' are subject to forty-five per cent duty. Where can the line be drawn? An astronomical telescope is evidently philosophical, as the word goes. But there are instruments of every grade, from the 26-inch equatorial to the little glass through which the opera-goer contemplates the movements of his favorite *prima donna:* shall they all be classed together? If not, who can define what telescopes, spyglasses, binoculars, lorgnettes, microscopes, and other instruments for aiding vision, are entitled to patents of nobility which shall distinguish them from the plebeian mass of 'manufactures not specially provided for in this act'? Of course the same question arises in the case of chemical and physical instruments of all sorts, which may be used either in a laboratory, private or public, in a factory or telegraph-office, or in a children's playroom. It is understood that the aid of the National academy of sciences will be invoked to furnish a solution of the problem, and the result will be looked for with great curiosity.

THE PROBLEM, how to make scientific assemblies more profitable to those who attend them, is constantly recurring. It is conceded that the more profound and special a paper may be, the fewer will be the number of those who take an interest in hearing it. On the other hand, if those who are special and profound are not to be encouraged to present their papers to scientific associations, who shall have the privilege? Certainly not the vague and the shallow. Papers must be presented, as elaborate and recondite as can be secured; but such papers repel the auditors. What shall be done in the dilemma? How can the mathematician presenting some new development of the theory of functions expect to interest the botanist? How can the petrographer discussing the microscopic aspects of rocks command the attention of the morphologist? Or, in a philological association, how can an elaborate paper on some point in the grammar of the Vedas command the attention of linguists who have never learned the Sanscrit alphabet? Has the advancement of knowledge reached such a point that there is no place left for the general society, the academy of science, and is specialization to be so special that each line of inquiry is to be considered only in a limited company of those who are devoted to it?

We venture to make a few suggestions which seem to us worth considering by those who are called upon to manage scientific meetings, especially the annual gatherings which bring from a great distance, at a great expense, those who are desirous of securing the utmost advantage from the meeting. *First*, Let the committee in charge make arrangements of a positive character for the conduct of the meeting, and require conformity to their regulations. Among these rules should be, (1) a strict adherence to the allotted time; (2) the presentation, in advance, of an abstract of what is to be read (and this should be printed, particularly if it contains any tabular statement, mathematical formulas, chemical formulas, or other rigidly technical statements); (3) the allowance of a definite time for discussion, questions, answers, and comments. *Second*, Let every speaker or reader form the habit of stating in general terms the purpose of his investigation, its relations to other work, and its results, refraining from going into minute details unless he is sure that a considerable part

of the audience can follow him. Let him always remember that there are some statements which the mind cannot readily receive through the portal of the ear; and there are but few which cannot be simultaneously presented, both to the eye and the ear. The diagram, the printed formula, the abstract, may cost the speaker a little expenditure; but it will save the hearer a vexatious outlay of time and attention. *Third*, Let there be a liberal margin allowed for social intercourse outside of the meetings, not merely for public receptions and excursions, but for those informal introductions and interviews which to many persons are the best part of scientific gatherings. We should not then hear it said so often, "This would have been a very pleasant meeting were it not for the papers which were read."

A REMARK made in one of the papers read before the recent Woman's congress in Baltimore suggests an interesting argument in favor of the kindergarten. It is well known, that, in its development, each new-born being passes through very much the same stages that his ancestors have been through before him. Even after birth, the growth of the child's intelligence simulates the progress of the human race from the savage condition to that of civilization. It has been shown by Preyer, and others who have studied infant-development, that a faculty which has been acquired by the race at a late stage is late in making its appearance in the child. Now, reading and writing are arts of comparatively recent achievement. Savage man could reap and sow and weave, and build houses, long before he could communicate his thoughts to a person [illegible] a distance by means of written speech. [illegible] is, then, reason to believe that a child's [illegible] intelligence would be best trained by [illegible] skilful in many kinds of manual [illegible] to torture him with [illegible] o be derived is, that p[illegible] d be instruction in manu[illegible] t reading and writing could be [illegible] asure and with ease by a child who had been fitted for taking them up by the right kind of preparation. The argument is a novel one, and it certainly seems plausible.

LETTERS TO THE EDITOR.

Change in the color of the eye.

In *Science*, p. 367, you say the color of the iris 'after early childhood' 'does not vary with age:' I think I can give you positive evidence that it does. My own eyes were called black (in reality dark brown) until after I was forty years old. About that time they commenced to change, and are now blue-gray, with streaks of light hazel, which last are fast fading out. The same thing happened with my father's eyes. I remember him at forty years and under, with thoroughly black eyes, and there are portraits of him which show him thus; but between forty and fifty, his eyes changed, and eventually became a blue, with a very slight tint of hazel, not noticeable without close observation. THEODORE F. McCURDY.

Norwich Town, Conn.

The eggs of Ornithorhynchus.

The editorial comments in a recent number of *Science* (p. 412), on the revival of forgotten statements, lead me to believe that some more old matter may be revived with profit. The telegram sent to the meeting of the British association from Professor Liversedge, announcing the fact ascertained by Mr. W. H. Caldwell (*Science*, iv. 261), that Ornithorhynchus lays eggs, has been universally hailed as an entirely new discovery; and a number of the prominent British zoölogists, whom we had the pleasure of welcoming to Washington recently, were unaware that the oviparity of the monotreme had long before been definitely announced, and an egg figured. Nevertheless, such is the fact; and an extensive series of old comments and applications of the fact appears in the literature of zoölogy. I need only refer to some of the most prominent, and others can follow up the subject in the publications of the day.

In 1829 Geoffroy Saint-Hilaire published a memoir in the *Annales des sciences naturelles* (xviii. 157–164), in which he reproduced a *figure of an egg* of the natural size (pl. 3, fig. 4). This was communicated to him by Prof. Robert E. Grant of London, who drew one of a nest of four obtained by a Mr. Holmes. Two of these eggs were reported to have been obtained by the 'Muséum de Manchester;' and it would be well for our Manchester friends to hunt them up, and see whether they are still to be found. As a result of a general belief in the oviparity of the animal, several of the naturalists of the day revised the classification of the vertebrates.

In 1830 Dr. Joh. Wagler, in his 'Naturliches system der amphibien,' proposed a peculiar class (Gryphi—Greife), in which, however, by illegitimate assumptions, he included the ichthyosaurians, plesiosaurians, and pterodactyles.

In 1831 Charles L. Bonaparte, prince of Musignano, in his 'Saggio di una distribuzione metodica degli animali vertebrati,' also isolated the monotremes as a peculiar class (Monotrema), defining it in the following terms: "I Monotremi sono animali vertebrati, a sangue calido, *ovipari*, quadrupedi; respirano per mezzo di polmoni; hanno un cuore biloculare biaurito."

And even long before the egg was thus figured,

and, it may be said, the oviparity of the monotremes firmly established, the fact had been authoritatively proclaimed. Sir John Jamison, for instance, especially declared that 'the female is oviparous, and lives in burrows in the ground' (*Trans. Linn. soc. London*, xii. p. 585). The Rev. Dr. Fleming, in his 'Philosophy of zoölogy' (ii. 215), published in 1822, remarked, that, "if these animals are oviparous (and we can scarcely entertain a doubt on the subject, as *the eggs have been transmitted to London*), it would be interesting to know the manner of incubation." Further, Fleming refused to admit the monotremes among the mammals, dividing the Vertebrata 'with warm blood' into 'quadrupeds' and 'birds,' and the former into 'I. Mammalia' ('1. Placentaria' pedota and apoda, and '2. Marsupialia'), and 'II. Monotremata.'

But, notwithstanding all these facts, scepticism as to the truth of the representations and authenticity of the eggs, developed into positive disbelief; and Bonaparte himself recanted, and took that decidedly retrograde course, which others had entered upon, of associating the monotremes with the marsupials in the unnatural and artificial negative group of Ovovivipara, or Implacentalia. I, too, was so far influenced by the prevalent scepticism or disbelief, and by the similiarity of the monotreme egg to that of a reptile, that I retained viviparity as a special attribute of the mammals in 1872, although I declined, on other evidence, to include a small size for the eggs in my diagnosis of the class. I then, also, adopting the subclasses Monodelphia, Didelphia, and Ornithodelphia, segregated them into the major groups, combining the first two under the name Eutheria, and contrasting the last as the Prototheria. These names have since been accepted by Professors Huxley, Flower, and others; and, inasmuch as Professor Huxley did not accredit their origin, they have been ascribed to him. I must add, however, that Professor Huxley has restricted the name Eutheria, although apparently with a hypothetical qualification, to the monodelphs, while he has coined a new name (Metatheria) for the marsupials. I fail to appreciate the need for such modifications, which virtually become exact synonymes of Monodelphia or Placentalia, and Didelphia.

Finally, the old data as to the oviparity of monotremes became almost lost to memory, so that no one has recalled them since the rediscovery. In view of such forgetfulness and scepticism, therefore, further information was necessary to insure the admission of the old evidence as valid. But Mr. Caldwell has further added the intelligence, quite new, that the eggs of Ornithorhynchus are meroblastic. This discovery will have an important bearing on the question of the origin of the mammals, and is antagonistic to the suggestion of Professor Huxley that the type was a direct derivative from the amphibians, while it increases the possibility that Professor Cope may be nearer the truth in affiliating the ancestors of the mammals to the theriomorphous reptiles of the Permian.

THEO. GILL.

Sun-spots.

The long-delayed maximum of solar spots, now undoubtedly passed, has attracted unusual attention to the spot-periodicity. To-day and yesterday the visible hemisphere of the sun was, for the first time in nearly fourteen months, observed to be entirely free from spots; the occasion next preceding this being 1883, Sept. 25. During the past two years, the only additional days on which the sun was observed to be without spots were, in 1882, Oct. 9 and Dec. 3, and, in 1883, Feb. 23, and May 25, 26, 27, and 28.

DAVID P. TODD.

Lawrence observatory, Amherst, Mass., Nov. 8.

The numerical measure of the success of predictions.

Suppose we have a method by which questions of a certain kind, presenting two alternatives, can in every case be answered, though not always rightly. Suppose, further, that a large number of such answers have been tabulated in comparison with the events, so that we have given the following four numbers:—

(aa), the number of questions for which the answers were the first way and the events the first way;

(ab), the number of questions for which the answers were the first way and the events the second way;

(ba), the number of questions for which the answers were the second way and the events the first way;

(bb), the number of questions for which the answers were the second way and the events the second way.

Then the problem is, from these data to assign a numerical measure to the success or science of the method by which the answers have been produced. Mr. G. K. Gilbert (*Amer. meteorological journal*, September, 1884) has recently proposed a formula for this purpose; and I desire to offer another.

I make use of two principles. The first is, that any two methods are to be regarded as equal approximations to complete knowledge, which, in the long-run, would give the same values for (aa), (ab), (ba), and (bb). The second principle is, that if the answers had been obtained by selecting a determinate proportion of the questions by chance, to be answered by an infallible witness, while the rest were answered by an utterly ignorant person at random (using *yes* and *no* with determinate relative frequencies), then the approximation to knowledge in the answers so obtained would be measured by the fraction expressing the proportion of questions put to the infallible witness. The second witness may know *how often* he ought to answer 'yes;' but I give him no credit for that, because he is ignorant *when* he ought to answer 'yes.'

Let i be the proportion of questions put to the infallible witness, and let j be the proportion of questions which the ignorant witness answers in the first way. Then we have the following simple equations:—

$$(aa) = i\{(aa) + (ba)\} + (1-i)j\{(aa) + (ba)\},$$

$$(ab) = (1-i)j\{(ab) + (bb)\},$$

$$(ba) = (1-i)(1-j)\{(aa) + (ba)\},$$

$$(bb) = i\{(ab) + (bb)\} + (1-i)(1-j)\{(ab) + (bb)\}.$$

Now, whatever the method of predicting, these equations can always be satisfied by possible values of i and j, unless the answers are worse than if they had been taken at random. Consequently, in virtue of the two principles just enunciated, the value of i obtained by solving these equations is the measure of the science of the method. This value is,

$$\begin{aligned} i &= \frac{(aa)}{(aa)+(ba)} - \frac{(ab)}{(ab)+(bb)}, \\ &= \frac{(aa)}{(aa)+(ba)} + \frac{(bb)}{(ab)+(bb)} - 1, \\ &= \frac{(aa)(bb) - (ab)(ba)}{\{(aa)+(ba)\}\{(ab)+(bb)\}}. \end{aligned}$$

Mr. Gilbert's formula has the same numerator, but

a different denominator. It is, in the present notation,

$$i = 2\frac{(aa)(bb) - (ab)(ba)}{\{(aa)+(ab)\}\{(ba)+(bb)\} + \{(aa)^2+(ab)^2+(ba)^2+(bb)^2\}}$$

For Sergeant Finley's tornado-predictions, $(aa)=28$, $(ab)=72$, $(ba)=23$, $(bb)=2,680$. From these data, Mr. Gilbert finds $i = 0.216$, while my formula gives $i = 0.523$.

If the questions should present more than two alternatives, it would be necessary to assign relative values or measures to the different kinds of mistakes that might be made. I have a solution for this case.

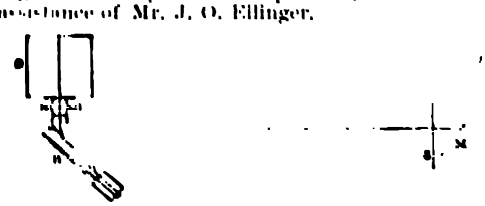
Another problem is to measure the utility of the method of prediction. For this purpose, let p be the profit, or saving, from predicting a tornado, and let l be the loss from every unfulfilled prediction of a tornado (outlay in preparing for it, etc.); then the average profit per prediction would be,

$$\frac{p\,.\,(aa) - l\,(ab)}{(aa)+(ab)+(ba)+(bb)}.$$

C. S. Peirce.

Measurement of the speed of photographic drop-shutters.

The usual method adopted for this purpose depends on photographing a white clock-hand revolving rapidly in front of a black face.[1] The chief difficulty in this case is to maintain a uniform rotation at high speed. To avoid this difficulty, and to determine the uniformity of exposure of any particular shutter under apparently like circumstances, the following method has been suggested. In carrying out the experiment in practice, I have had the assistance of Mr. J. O. Ellinger.



A tuning-fork, R, with a mirror attached to the side of one of the prongs, is placed in front of the camera-lens. This mirror is so arranged as to reflect into the camera, C, a horizontal beam of sunlight, which, before reaching the fork, has passed through a half-inch hole in a screen, S, placed about ten feet distant. This produces on the ground glass a minute brilliant point of light. If the fork be set vibrating, the point will become a short, fine, horizontal line: if the fork be rotated about its longitudinal axis, the line will become a sinusoidal curve described on the circumference of a circle of long radius. A photographic plate is now inserted, and the drop-shutter attached. On releasing the latter, it will be found that a portion of the sinusoid has been photographed; and the precise exposure may be determined by counting the number of vibrations represented on the plate.

The mirror employed should be somewhat larger than the lens to be measured, so as to cover its edges during the whole exposure. The mirror may be glued directly to the prong of the fork with strong carpenter's glue, aft r the ... ing off a little of the silvering at the edge ... ess. The rate of the fork is then d... mparison with a standard fork, by t... s. W. H. Pickering.

Photogra... Mass. H...

[1] ...ing othe... ...at Mas... ...s. plates .. y, Aug. 31.

THE IMPORTANCE OF CHEMISTRY IN BIOLOGY AND MEDICINE.

The position of chemistry in the biological sciences has long been, in English-speaking communities, a very indefinite one: in fact, it may be questioned whether the science has, even at the present day, any generally recognized position among biologists themselves. That this has been the case for many years, even in Europe, is evident from the fact that until recently the published results of investigation in the field of physiological chemistry have had to be sought for in widely diverse places. Many papers have been published in purely chemical journals, others in journals devoted to physiology, while still others have appeared in so-called 'natural-history' journals, — a fact which in itself plainly indicates the past status of this branch of science.

There can be no question that physiological chemistry should occupy a definite place among the biological sciences. Biology is confessedly a study of life, and, as such, has to do with the development, structure, and function of living organisms. The first two of these we suppose to be included under the heads of embryology and morphology: while the third, constituting, in the words of Herbert Spencer, "the second main division of biology, embracing the functional phenomena of organisms, is that which is in part signified by physiology." Further, "that part of physiology which is concerned with the molecular changes going on in organisms is known as organic chemistry," or, with equal propriety, as physiological chemistry: hence a study of the functions of the body, to be at all complete, must include a study of the chemical changes incident to life, and cannot be restricted to the purely physical phenomena of the organism. Yet it is very noticeable that wherever 'biology' is taught in this country, even in the most liberally conducted institutions, where the course of study embraces embryology, animal and vegetable morphology, experimental physiology, etc., physiological chemistry is rarely mentioned.[1]

We need to inquire whether this is due to a

lack of appreciation of the importance of the subject, or whether it is generally considered as outside the pale of biological inquiries. We are more inclined to believe that the rapid development of the past twenty years in the various branches of biology, so divergent from chemistry, has tended to push into the background the chemical phenomena of life to such an extent that the existence of chemical science as a part of biology is in danger of being forgotten.

Physiology in its entirety, dealing with all the functions of the living organism, both animal and vegetable, is truly a broad subject; but that by itself does not constitute a sufficient reason why the chemical composition and chemical processes of the organism should be so seldom studied. By this it is not meant that all applications of chemistry to physiology are overlooked, or that there is an utter lack of appreciation of its importance, but rather that the average instruction in physiology in this country, and apparently likewise in England, disregards almost every thing pertaining to chemistry, aside from the common fundamental facts; so that, whether as a part of physiology, or as physiological chemistry, the average student in biology acquires but little knowledge of the chemical processes of the animal organism; by 'knowledge' being meant that personal knowledge, which, in the case of an experimental science, can be obtained only in a properly equipped laboratory.

But while in America little has been done either to advance or to teach the chemical side of physiology, in Europe it has been very different, until now as a growing science, following a natural law of progressive division of labor and of thought, the chemical phenomena of the living body have massed themselves together, and, aided by increased interest and added workers, a division of physiology has become necessary; and to-day there exists, in Germany at least, a new science, or rather a specialized portion of an old one, viz., that of physiological chemistry.

We would lay all possible stress on the important position of physiological chemistry in Germany, its relation to medicine and biology in general, the large number of important researches emanating from her laboratories, and on all that tends to make the science so progressive in that country; and then, by contrast, how small and insignificant appears the little work done in our own country! If we look to the biological laboratories of our colleges, to our medical schools, and to the laboratories connected with our hospitals, we find an almost utter lack of work tended to increase the boundaries of the science. Seldom do we hear of a piece of original work in physiological chemistry; and few American names are being added to that long list of German investigators whose united work has made the science what it is to-day.

There is also a practical side to this question. Not every medical student, it is true, can become proficient in physiological chemistry, there is not time for it; but many a man gifted with powers of observation, and endowed with a love of knowledge, may find much to do of direct practical value to medical science. Every student of medicine should, however, possess some knowledge of physiological chemistry. Dr. Perkin, in his recent address before the Chemical society of England at its anniversary meeting, says, "If there is any value in chemical products as curative agents, if there is any value in physiological chemistry, or any importance in toxicology, surely medical students should have a sound knowledge of chemical science, and not simply learn to detect an acid and a base in a mixture, — an operation which is of no value, except as an intermediate exercise to be followed by more advanced work."

What is needed in this country is a fuller appreciation of the importance of physiological chemistry, both in biology and in the science of medicine. A host of questions are to be answered regarding digestion, nutrition, respiration, etc., — questions to be answered only through the agency of chemical science; and, if America is to do her share in the clearing-up of the mysteries surrounding the chemical processes of the living organism, physiological

chemistry must be raised to a higher plane among the biological sciences.

THE NAVIGATION OF THE NILE.

The Nile, which during thousands of years has attracted much attention from the intelligent portion of mankind, yet remains in many respects the most interesting of the great rivers of the globe. Its sources, which for so long a time were a mystery, have within the last quarter of a century been rediscovered: but that rediscovery has only rendered it more interesting, and more worthy of study.

The great fluctuations in its flow, and the remarkable, almost mathematical, regularity, year after year, of these fluctuations, can now be practically studied, and their causes clearly understood.

Having its great first reservoir under the equator, we now know that it derives its waters from the region between a few degrees south of that line, and latitude about 13° north. It receives its last affluent, the Atbara, south of latitude 13° north, and yet continues its flow, notwithstanding evaporation, receiving nothing, and giving life to the lands it traverses, until it pours the waters of south central Africa into the Mediterranean Sea, in latitude 32° north, carrying in those waters, each year, masses of the *débris* of the mountains of the interior to continually fertilize and extend its delta.

Early in June of each year the flow is the least. The current near Cairo has then a rapidity of only a little more than one mile per hour, and the amount of water passing is only from four hundred to five hundred cubic yards per second. Before the end of June the annual rise commences; and by the end of September the rapidity of the current reaches nearly, if not quite, three and a half miles per hour, the quantity of water passing a given point becoming from *nine thousand* to *ten thousand* cubic yards per second.

Late in October, or early in November, it commences a somewhat rapid decline, which continues until January, when the decline becomes more gradual and regular; this gradual decline contin[illegible] til about the end of May, when t[illegible] flow is again reached, to give [illegible] wing month to the new annual.

The [illegible] of the fluctuations is due to t[illegible] ces of supply, and the admirabl[illegible] servoirs and checks which na[illegible] rovided.

The Egyptian Nile is formed by the junction, at Khartum, of the Blue Nile and White Nile.

The Blue Nile (*Bahr-el-Azrack*), taking its rise in the centre of Abyssinia, and fed by the rains which yearly fall in the mountains of that country during the months of April, May, June, July, and August, furnishes the great masses of water which cause the rapid summer rise, and also furnishes the rich silt, which, torn from the mountains of Abyssinia, spreads over the cultivatable lands of Egypt, and yearly renews the fertility of those lands.

The White Nile (*Bahr-el-Abiad*), flowing from the great reservoir under the equator, guarded in that and the subordinate reservoirs, Lake Ibrahim and Lake Albert, and guarded also by the great system of dams called 'the cataracts,' furnishes the steady flow of clear water which continues throughout the year.

No human engineer has ever devised, on any thing like so grand a scale, so admirable a system for the collection, preservation, and distribution of irrigating waters, as has there been formed by nature for the supply of Egypt.

Lake Victoria, with a surface of some forty thousand square miles, collects and stores, for the use of the Sudan and Egypt, the rain-water falling on a basin of more than a hundred and sixty thousand square miles of surface. The average yearly rise of the lake may be fairly taken, according to observations made on the spot, as two feet, which gives for distribution through its only outlet, the Victoria Nile (the Somerset of Speke), the enormous volume of more than sixty-eight thousand million cubic yards of water per annum, or more than two thousand cubic yards per second.

It will be seen that this storage is so well devised, that, in order to give *one inch* of rise to the Victoria Nile, more than *twenty-eight hundred millions* of cubic yards must be stored in this great reservoir.

Then come the two secondary reservoirs,—first Lake Ibrahim (discovered by Col. Long in 1874), in latitude north $1\frac{1}{2}°$, which must be filled before the flow can continue on towards Egypt; and then Lake Albert, which must be filled over its surface of perhaps three thousand square miles before the direct distribution of waters through the White Nile can fairly commence. But this is not all that nature has there done to regularize the great distribution. Between Lakes Ibrahim and Albert, there is a great system of natural dams in the cataracts which are found between Foweira and Lake Albert. Then coming north, down the White Nile, we find, first at Duffli, and soon again at Beddin, successions of rapids, the results

natural dams; and these we find between Khartum and Berber, be-[...]-Hamed, between that and Dongola, [...]ween Dongola and Wadi-Halfa. At [...]named place is found what is called [...]nd cataract; and still farther down the [...]f the river, at Assuan, is the well-[...]first cataract.' Thence to the sea the [...]f the great river is unobstructed in its [...]cept by the works of man. The great Mehemet-Ali, caused, at immense [...] construction of the famous *barrage* ('the dam of the Nile') a few miles [...]rth of Cairo, in the endeavor to make [...]plete, by a dam, what nature had so [...]e in Central Africa and Nubia for regular irrigating-supplies.

[...]ataracts which play so important a [...]he preservation and regulation of the [...]r, are formed by masses of granite [...]hich at intervals cross the course of [...]am, making enduring dams. It is [...]perceive, that, should they be worn [...]destroyed, the flow of the river would much more rapid during the seasons [...]water; and the Nile would become, in [...] fierce torrent during high water, and [...]dry channel for a considerable portion [...]ear.

[...]atural destruction of these great dams [...]rmation of pot-holes, and the friction [...] passing over them, is, from the nature [...]ock, very slow. From such observa-[...]have been made, it is probable that [...]ral wearing-away hardly exceeds six [...]one thousand years; and there is a [...]nding effect in the natural rising of [...]r-bed below the cataracts and in the [...] the deposit of silt from the turbid [...]

[...]ile is navigable at all seasons of the steamboats of light draught, from the [...] Assuan (the first cataract), between [...] and second cataracts (Assuan to [...]alfa), between near Berber and Khar-[...]ween Khartum and a point a little to [...]h of Gondokoro, and between Duffli [...]e Albert. It is only during the season [...]water that boats can descend the Nile, [...] the cataracts between Berber and [...]

[...]reat danger to boats descending these [...]pids during high water is found in the [...]ear the river-banks, islands, and large [...] The current is so rapid, and the fric-[...]either hand so great, that the water [...] *heap up* in mid-channel, where the [...]s the strongest; and great skill on the part of the steersman, and prompt and vigorous work on the part of the engineer of the steamer, or oarsmen of a row-boat, are necessary to keep the boat on the ridge of the current. If the boat is permitted to slide off this ridge, she is quickly caught by the eddies, and almost invariably lost. This is so well understood by the Nubian boatmen, that, while they work with a will at the oars in these descents, they always have their personal effects packed in a snug parcel beside them, ready to seize; and they leap overboard, each with his parcel on his head, the moment the boat gets into a hopeless position.

The work of towing or warping boats up against the current is more difficult, but far less dangerous, than the descent.

CHAS. P. STONE.

A MUSSULMAN PROPAGANDA.

THE attention of geographers has of late been particularly attracted by the operations of a Mussulman confraternity known as the Sénousians, or the Brotherhood of Sidi Mohammed Ben Ali es-Senousi, the founder of the order. Of this now powerful and widely ramifying society, Henri Duveyrier has recently given an account. Its operations are of importance to civilization, not merely from the relation of this order to existing religions, but from that which it bears to the efforts being made by civilized nations to develop the dark continent, and explore its geographical and other mysteries. The success of the religious propaganda which the society represents menaces not only projected explorations, but the very existence of established colonies and international traffic. It is believed that to their instigation is due the melancholy fate of many African explorers of late years, among whom may be mentioned Dournous Dupéré, Beurmann, Von der Decken and his party, Col. Flatters, Capts. Masson and Diarnous, Dr. Guiard, Béringer, Roche, Mademoiselle Tinné, Sacconi, and others. If the present crusade in the Sudan be not wholly due to their machinations, it has at least been actively assisted and impelled by individual members of the society, and guided by the blind fanaticism which is its rule of conduct. The favorite motto of the head of the order declares Turks and Christians to be equally offensive, and doomed to an equal and simultaneous destruction. Their monasteries and influence extend from Morocco to Arabia, and from the Mediterranean to Mozambique, and govern two or three millions of peo-

ple. Under their teachings, peaceable blacks, who formerly welcomed trade and civilization, or did not oppose it, have become ferocious bigots; and large areas have thus been utterly closed to intercourse with the whites, unless accompanied by an army. A brief summary of the history and tenets of the fraternity will not be valueless.

Of the religious societies which have flourished in the bosom of Islam, the present is one of the latest, but, during the forty-seven years of its existence, has attained a far greater success than any of its predecessors.

Its founder was of the tribe of Medjaher, from the vicinity of Mostaghanem in Algeria, born during the last phases of the Turkish occupation, of which he was the declared adversary. Exiled to Morocco, he was initiated through the fraternity of Mulei Taïeb into the mystic philosophy known to orientalists as Chadheliya, or Chadhelism. He returned to his native land about the time that Algiers was taken by the French. He travelled as a teacher of law and philosophy through the highlands of Algeria, gradually making his way eastward toward the holy places of Arabia, attracted by the renown of the theologians gathered there, and especially of Ahmed Ben Edris, the patriarch of Chadhelism at Mecca. This philosophy was already tinctured with Wahabi radicalism; and in the course of his travels, stopping to give courses of instruction, and expound his views in various cities, he became equally obnoxious to the representatives of the established doctrines, and to the government of Egypt. Arrived at Mecca, he became first the pupil, then the successor, of the sheikh Ahmed Ben Edris. His first attempt to make converts in Yemen, on a journey with that end in view, was unsuccessful. He returned to Mecca, and addressed himself more particularly to the Berber pilgrims, to whom he taught what he called the 'way of Mohammed,'—a title afterward altered to the 'way of es-Senousi.' By this he intended a sort of reformed Chadhelism, partly drawn from the Korán and its commentators, and partly from his own meditations, which he presented to his pupils as the pure faith of Islam, disembarrassed of the theological incrustations of twelve centuries of theologians. This religion was distinguished from the first by its claims to absolute authority; and the writings in which his views are summarized bear the pretentious title of 'The rising suns.' His resolution of forming a religious order bore fruit about 1837. The object of the fraternity was to teach the following doctrines, among others: the exaltation of God, to whom worship is alone reserved; living saints may be venerated as permeated with the spirit of God, but this ceases with their death; their tombs must not be the goal of pilgrimage, nor their names used as intermediaries in prayer (even Mohammed forms no exception); the novice renounces the world, he will respect the authority of the caliph so long as the latter respects the society; political ambition must not be exercised against a true believer, but becomes a duty and a merit as against one who does not accept the true way, that is, the 'way of es-Senousi.'

Luxury and ornament are prohibited. Gold is reserved for the sword to be drawn in a holy war. Women, however, are excepted from these rules. Drunkenness, tobacco, and coffee are prohibited; tea allowed, if sweetened with brown sugar, the white sugar being impure, as refined by the use of bones of animals killed by unbelievers. It is forbidden to serve or to speak to a Christian or a Jew, or even to bow to them. Unless they are tributaries or slaves of believers, they are to be considered as outlawed enemies, to be robbed or killed at the most convenient opportunity. The society is allowed to fraternize with other Chadhelistic orders, — a condition of great importance, and to which much of its success is due. Almost all the Mussulman orders which at first repudiated the new doctrine have come to acknowledge its supremacy, and to conform to its policy.

The fraternity maintains itself in mystery. The acolytes wear no distinguishing dress or mark, their rosaries are similar to those commonly in use, and the supplementary prayer which they add to the usual matin is communicated only to members of the order.

The society holds convocations, prescribes pilgrimages to its monasteries, levies a tax of two and a half per cent on the capital of its followers for the treasury of the order. Those too poor to contribute money or stock render service as laborers, artisans, emissaries, spies, or even assassins. All means are held good toward their desired end, even the arts of light women being employed in cases where ruder influences have been repulsed. The order administers justice to its followers and those under its influence. For instance: in the Ottoman vilayet of Ben-Ghazi, in Barca, the authorities have even gone so far as to depute the administration of justice to the order. In all north-eastern Africa except Egypt the Mussulman swears by 'the truth of Sidi es-Senousi,' as formerly by that of Mohammed. Mild when weak, the order becomes defiant

cure establishment, and even dared, in to excommunicate the sultan, Abd el- for failing to respect its pretensions.

operations of the order are carried on ystem of graded officers, priests, and iaries, which, as well as their adroit and methods, strongly recall the marvellous zation once attributed to the order of . Nor has the result been less success- 'ribes alien and unreceptive, rulers cold ous, populations indifferent or con- ous, have been won over and firmly at- to the order. The hard-worked native rs his field to the society, preferring to treasures in heaven. The fraternity ells in the desert, revives withered oases, s its votaries from the nomad thieves of iara, buys, instructs, and frees slaves, ids them to their distant homes as mis- es, with astonishing results.

headquarters of the order are at the or convent, of Jarabub, founded in on the 30th parallel, near the western of Egypt. Its population has increased lously during the last ten years. The as originally a desert. The society built irs, began plantations, erected con- and in 1880 the body-guard of the head order was estimated to consist of four id men and about two thousand slaves. etropolitan is the son of Sidi es-Senousi, genius he would appear to inherit, and vn as Sidi Mohammed el-Mahdi, having, e false prophet of the Sudan, assumed, 'ather's instigation, the title equivalent loslem messiah. The convent has be- n arsenal, possessing large stores of nd ammunition, and even fifteen cannon sed at Alexandria. Aid and comfort ishly extended to those who have from o time revolted against France in l.

wise to inaugurate as yet the holy war ed of El-Mahdi, the head of the order evertheless, provided against external sion. Suspecting that its propaganda entually rouse the arms of civilization it, it is said that there are constantly the zaouia of Aziat in Cyrenaica, for e, five hundred camels with their har- id equipments, drivers, etc., ready at a t's notice to convey to the interior the and property of the Senousian authori- The fraternity possesses one of the best n North Africa, — Tobrug, — where an nate trade flourishes, and does not r manufactories of powder.

ce is, so far, the only civilized nation which has suffered directly from the policy of the order. In Algeria most of the rebellions of late years are attributed to the new propaganda. The insurrections there have been imitated in the French district of Senegal. We have already referred to the probable connection of the order with recent events in the Sudan.

We have refrained from entering into a multitude of details which support the preceding conclusions, and it is not necessary to recount the different tribes and petty African states which have gradually become converts to the views of the fraternity. Enough has been said, however, to indicate the unsuspected importance of this new factor in the politics of Africa. The blood of many explorers and travellers bears testimony to the violence of its fanaticism; and neither the geographer nor the anthropologist can regard with indifference a movement which falls little short of that which originally propagated the faith of Islam.

W. H. DALL.

THE RUBY-HILL MINES, EUREKA, NEV.

MR. J. S. CURTIS, whose report on the silver-lead deposits of Eureka, Nev., is now in press, has prepared for exhibition at the New-Orleans exposition, by the U. S. geological survey, a model of the Ruby-hill mines, from which the largest portion of the metals extracted in the Eureka district has been taken. This model is eighteen inches in height, and about four feet long by eighteen inches wide. It is composed of glass plates horizontally arranged at distances of one inch apart, each inch representing a hundred feet, and the glass plate showing a section at each mine-level in the body of the model, the mine levels being that distance apart. The upper plates, however, are closer together, and are cut to show the contours of the surface at distances of fifty feet apart.

On these plates the geological formations, three in number (quartzite, limestone, and shale), all of the Cambrian period, are colored with transparent colors. The ore-bodies, occurring only in the limestone and of tertiary or pre-tertiary age, are very irregular in form, and are shown by opaque red paint; while the mine-workings, shafts, tunnels, etc., are represented in opaque black paint. The effect of the model is as though a skeleton of the mine-workings and ore-bodies were seen suspended in a solid glass mass, the coloring of the geological structure not interfering with the view, on account of its transparency.

The dominant factor of the structure of Ruby Hill is an extensive fault, which has determined the present relations of the formations. The presence of this fault is marked by a fissure filled in places with rhyolite. This fissure also forms the hanging-wall of the ore-zone. Above the water-level the ore is prin-

cipally galena, anglesite, mimetite, and wulfenite, with very little quartz and calcite, the gangue being for the most part hydrated oxide of iron. It also carries gold and silver, and zinc is present probably as a silicate. Below the water-level it is composed chiefly of pyrite, arsenopyrite, galena, blende, and a few other sulphides, besides silver and gold.

The ore-deposits are confined to a mass of crushed limestone between the main fault and the quartzite. Those of any size are always capped by caves, or in some way connected with them and with fissures. The caves were probably formed subsequent to the deposition of the ore, being due, partly to the action of water carrying carbonic acid, and partly to shrinkage of the ore from decomposition. Since the latter occurred, the ore has in many instances been redistributed by the flow of underground waters, whose former presence is indicated by stratification of portions of the ore-bodies, and by traces of aqueous agencies in the surrounding limestone.

The constituents of the ore were probably derived by solution from some massive rock, not sedimentary, as assays of the country rock show that they could not have been so derived. The solutions were due to solfataric action, incident to the eruption of large masses of rhyolite. They entered the limestone from below, through fissures; and the greater part, at least, of the ore, was deposited by direct substitution for that rock. The limestone was fissured and crushed in many directions by the various faulting movements, and gave free ingress to the ore-bearing solutions, which naturally followed the channels of least resistance, and deposited the ore in masses of very irregular form. These are well shown in the model.

From the year 1869 up to the present time (1884) the Eureka district has produced about sixty million dollars of gold and silver, and about two hundred and twenty-five thousand tons of lead: and, as already stated, the largest portion of these metals was derived from the Ruby-hill mines.

TWO LARGE SUN-SPOTS.[1]

THE figures of sun-spots given with this article are from drawings made at the observatory at Palermo, and represent two of the largest spots observed during the last two years, so remarkable for the number of spots seen. Not only was their extent (which is readily appreciated by comparison with the figure of the earth given on each plate) immense, but the changes which were seen to take place were most rapid.

The first appeared on the eastern limb of the sun on June 25, 1883, about at latitude +7° 55′. After undergoing various transformations, it offered, on the 30th of June, the curious aspect shown in fig. 1. The spot was double; and its extreme length from east to west was not less than ten earth diameters, or about 3′. Considerable movements were agitating it. Two days afterward, on the 2d of July, the two parts had separated, and between them the photos shone with marked whiteness. From day to this separation increased, until the 8th, when the disappeared on the western limb, after a devi toward the north of 2° 30′. From the 28th of to the 2d of July, long, brilliant tongues, endi

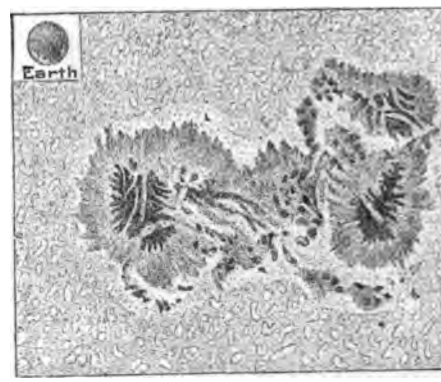


FIG. 1.

red hydrogen flames, were seen extending int umbra; and a yellow coloring was observed o penumbra and on some of the tongues, perhap to the presence of sodium (fig. 2).

This large spot was preceded and followed, o limbs of the sun, by small but brilliant solar p berances. It returned July 2, at latitude 8° 11′, smaller and more regularly shaped, to make once the tour across the disk of the sun, and disap at latitude +8° 23′, not to be seen again.

The second spot (figs. 3 and 4) was first seen

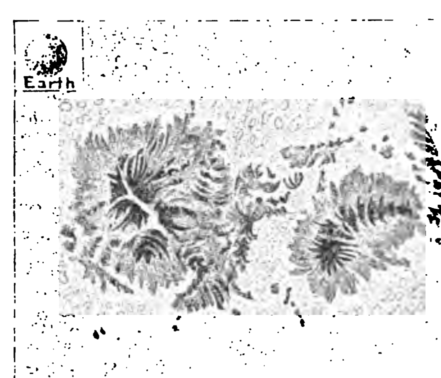
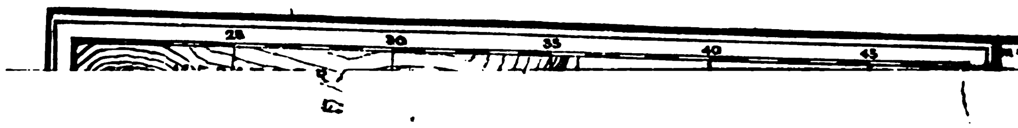


FIG. 2.

eastern limb, on the 10th of July, in latitude - It offered a strange appearance, and appeare the seat of much disturbance. On the 2 centre was covered with luminous points whi in constant motion; and some strange lines seemed to be suspended over the umbra. Th

[1] Reproduced, with the cuts, from *L'Astronomie*.



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that on the ship-

ton, as in 1825. On the Pacific coast wooden ...ding is still a growing industry.

...apter on iron ship-building offers some ... the condition of the more important ...d the cheapening of the cost of iron ... This is fortunate, for the next chap... ...s how thoroughly the eastern seaboard ... stripped of ship-timber; and, as well ...second-growth timber is very inferior. ...ply of yellow pine, now almost exclu... ...ed for planking, is reported large, but ...e it is growing more difficult to obtain ... quality of this useful wood. The ...oast still affords abundance of good ...ber, and the good character given to ...r shows that ship-building on the Pacific ... suffer for years to come. Tables of ...ific gravities and weights of the differ... ...ls used by ship-builders, by Prof. C. S. ... and the late Constructor Pook, U.S.N., ...n; and the report is closed with sta... ...of vessels built in the census year, ... of hands employed, wages, value of ...s, etc.

MINOR BOOK NOTICES.

...ric light: its history, production, and appli... ... By Ém. Alglave and J. Boulard. ...lated from the French by T. O'Conor ...e, E.M., Ph.D. Edited, with notes and ...ons, by C. M. Lungren, C.E. New York, ...on, 1884. 18+458 p. 8°.

...ascinating character of the subject, and ...t popular interest in it, have stimulated ...duction of pictorial treatises on elec... ...nd its practical applications. To the ...st many of these modern treatises ap... ...be uncalled for, or at least seem to be ... with much superfluous and unnecessary

...ere not a curious relation between the ...ve furnishing of the offices of many ...-light companies, where the unwary per... ...nduced to invest in stock which has only ...ginary value, and the luxurious editions ... treatises on the electric light? If the ...hould be embellished, why should not ...ks that treat of the wares of the com... ... of *éditions de luxe*?

... work of Alglave and Boulard, edited by ...ngren, contains much extraneous mat... ...t the general reader will find valuable ...ation in regard to the general features of ... lighting. The treatise does not pre... ... be an exhaustive presentation of the ... . One is surprised to find how much ...ting matter has been crowded into the

volume, notwithstanding so much space is given to large illustrations. Many of the latter are extremely amusing. One of them (p. 85) represents a street in New York lighted by the Brush electric lamps. On the pavement are many mercurial New-Yorkers, waving their hats; and one is so much overcome with enthusiasm, that he turns his back upon the *fait accompli*, and walks away with bared head. Should not this engraving be entitled 'A street in Paris'?

Report on the International exhibition of electricity, held at Paris, August to November, 1881. By DAVID PORTER HEAP, major corps of engineers, U.S.A. Washington, *Government*, 1884. 287 p. 8°.

IT will be interesting to the visitor to the Philadelphia electrical exposition to compare his recollections of that exhibition with Major Heap's report of the Paris exposition of 1881. He will find in this latter work a short and concise account of the principal types of dynamo-machines, and will discover that the new forms which were exhibited at Philadelphia differ only slightly from those described by Major Heap.

The report does not pretend to contain any measurements or calculations, and was necessarily somewhat hastily prepared. The electrician, however, will find it a valuable addition to his library.

A B C de la photographie moderne. Par W. K. BURTON, C.E. Traduit de l'anglais par G. HUBERSON. Paris, *Gauthier-Villars*, 1884. 112 p. 12°.

As its name implies, this work is intended for the beginner in photography, but it contains many hints that those of longer experience might profit by. Beginning with the choice of apparatus, and the arrangement of the dark room, the whole process of photography is described, including both methods of development, to the production of the finished print. The most prominent defect of the work is that the chapters on printing are rather too brief: indeed, there is no description at all of the processes of mounting and burnishing. The chapters on the production of the negative, however, are excellent, as is the one on defects and their remedies.

NOTES AND NEWS.

PROFESSOR Mell, director of the Alabama weather-service, announces, that through the liberality of the chief signal-officer, and of several railways, weather-signals, predicting changes of weath temperature, will be displayed at over one hı telegraph-stations in that state. The predictio be received by the director at an early hou morning from the signal-office in Washingto then promptly distributed along the railway paying for the cost of the signal-flags (about s lars), any town or telegraph-station will recei telegraphic warning of the daily weather-c Only about five minutes is required to set th A similar system has been for some time in op in Ohio and in part of Pennsylvania, and doubtless have farther extension.

— Herr Warburg has succeeded in electr glass by heating a piece of soda-lime glass to 300° C., at which temperature it is a conduct placing it between mercury electrodes. It was sary to use from fifteen to thirty Bunsen cell long period. He then found, that, at the anode the glass, he had a layer of silicic acid. Thi very quickly reduces the strength of the c owing to its bad conductivity.

— We learn from *Nature* that a tunnel mea about five thousand feet in length, and const at least nine centuries before the Christian e just been discovered by the governor of the of Samos. Herodotus mentions this tunnel, served for providing the old seaport with dri water. It is completely preserved, and c water-tubes of about twenty-five centimetres in eter, each one provided with a lateral apert cleansing-purposes. The tunnel is not quite st but bent in the middle: this is hardly to be wo at, as the ancient engineers did not possess n ing-instruments of such precision as those const nowadays.

— Heddebault has succeeded in separatin of cotton and wool, mixed, by subjecting them action of a jet of superheated steam. Under a ure of five atmospheres, the wool melts, and si the bottom of the receptacle; while cotton, line other vegetable fibres stand, thus remaining s for the paper-manufacture. The liquid mud contains the wool thus precipitated is then cated. The residue, which has received the n azotine, is completely soluble in water, and i able on account of its nitrogen. Moreover, its ration costs nothing; because the increased v the pulp, free from wool, is sufficient to cover t of the process.

— A Berlin correspondent of the *St. James* writes that an engineer named Fisher is repo have made an important discovery in aeronaut which he is enabled to condense or expand the a balloon. The agent he employs is compress bonic acid, with the help of which he can asc descend at pleasure. This perpendicular mo puts it in the power of the aeronaut to go up o until he finds a current of air moving in the h tal direction he wishes. Military critics at great importance to this discovery, because in

balloon will be able to reach the enemy's terri- and ascend again, without requiring a fresh of gas.

'eill, who has spent many years on his ex- nts, has, it is said, at last succeeded in coating taneously all the ordinary metals and their with a thin film of brass, which can be varied or. He uses only a single battery-cell, and s at will solid deposits of various hues and bril- The tints are stated to be due to the forma- copper oxides, the composition of which has t been determined.

ature states that the *Globus* reports the dis- of the ruins of an ancient city near Samar- They are situated upon a hill which was less a fortress formerly. Remains of utensils iman bones have also been found. According bian sources, the large city of Aphrosiab existed in the time of Moses: it was the royal resi- ; and the king's castle stood on the hill, and was led with subterranean corridors. The result of cavations shows that the ruins are indeed those ery ancient city. The various depths, however, widely. In the lower ones fine glass objects und, which are quite absent from the upper The lowest layers contain remains of a very ive nature, i.e., coarse implements of clay and The excavations are being continued. News Turkestan announces the discovery of another it city, Achsy, on the right bank of the Amu Remains of brick walls and other buildings id to be visible in considerable numbers.

The December number of the monthly meteor- al charts of the North Atlantic, described in ce, iii. 654, was recently issued by the Hydro- ic office, completing the set. It is announced ork in a similar direction has been begun for outh Atlantic.

November number of the North Atlantic chart is also just published. The bark Ethel he continues its zigzag way across the ocean, now reported for the sixth time. Two storm- are charted, one of tropical origin, noteworthy t advancing west of longitude 58° west, before ng to the north-east: the other storm seems to left our shores near Charleston, and then spent lays in turning round a sharp loop, and recross- s path, before finally moving away to the north-

After thirty-three years of duty, Gen. Isaac F. by has been compelled by ill health to retire the professorship of mathematics and natural sophy at the University of Rochester.

Ensign J. J. Blandin, U.S.N., has been ordered e navy department to the Johns Hopkins uni- y, for a course of study in physics and chemis-

. R. Hammersly & Co. of Philadelphia an- ce a work on Indian sign-language, by the late W. P. Clark, U.S.A.; and E. & F. N. Spon ince a practical treatise on the manufacture of , tiles, terra-cotta, etc., by Charles Thomas Davis; also a new book by I. Lothian Bell, entitled 'Principles of the manufacture of iron and steel, with some notes on the economic condition of their production.'

— Capt. Kostovich of the Russian navy proposes the use of a small captive balloon, to which an Edison lamp is suspended, for night signalling. By the aid of connecting-wires, the lamp may be lighted and extinguished at will, and the apparatus may thus be used with any of the codes in vogue.

— The report on the prizes offered by the Berlin royal academy of sciences was read at the July meeting. The Steiner prize for geometry was not granted, as no essay reached the required standard of excellence: the grant was therefore postponed until March 1, 1886, when it will be offered for the best geometrical treatise written in German, Latin, or French. One prize has, however, been accorded to Professor Fiedles of the Zurich polytechnic school, for his work in geometry. The subject for the Cothenius prize is, "By personal experiment and chemical research to ascertain the assimilation process of plants in light, and by direct proof show in the plant-fibres the primary assimilation products of the carbon in plants, distinguishing them from the similar products of transformation in the change of matter in the cells, and showing its chemical nature." As some approximate solution of the problem, a clear demonstration will be accepted of the present ideas on the assimilation process of plants, and the primary organic generations thereof by repetition of the series of observations and researches already made, and an important extension or limitation thereof. The Diez prize of the academy, of two thousand marks, has been granted to Professor Pio Rajna of Florence, for his work on the origin of the French epic.

— It is reported, says the *Engineer*, that the attention of the Indian government has been drawn to a tree in southern India, from which large supplies of caoutchouc can be drawn. This is the 'Teichmig' of the Chinese, or Prameria glandulifera of botanists. Unlike the South-American tree, from which the caoutchouc is tapped by piercing the bark, the gum is obtained from the new source by breaking the boughs, and drawing it out in filaments. If the new caoutchouc is at all equal to the old in insulating-properties, it will form a timely discovery; for the introduction of electric lighting has created an increased demand for india-rubber coated wires. Indeed, several inventors have lately been engaged in trying to manufacture a substitute for gutta-percha and india-rubber out of oxidized oils; that is to say, oils treated with chloride of sulphur, mixed with asphalt, ozokerit, and other insulating substances.

— The effect produced by Mr. Selim Lemström in his experiments on the artificial production of the aurora is well shown in the illustration on the next page, from a drawing by Mr. Lemström. On the top of the mountain a wire was stretched on poles, and furnished at every foot or two with brass points. This wire was several miles in length, and was carried over the top of the hill in the form of a spiral.

The poles were supplied with sulphuric-acid insulators in order to prevent, as far as possible, the creeping of electricity over their surfaces. From this insulated system of points a wire was run to a ground-connection at a lower level, perhaps from five hundred to a thousand feet below. If the ground-connection had been made on the same level, no current would have been observed; but when there was a difference of level, even if not more than thirty feet, a current was always observed from the higher point to the lower. The luminous effects portrayed in the cut were only visible to the naked eye when there was a marked display of northern lights; although by the aid of the spectroscope, which would show the peculiar spectrum of auroral light, the existence of the streamer could often be proved.

A VERTICAL SHEAF OF LIGHT OBSERVED, DURING A DISPLAY OF THE NORTHERN LIGHTS, ABOVE A SYSTEM OF WIRES ON THE TOP OF PIETARINTUNTURI, NEAR KULTALA, FINNISH LAPLAND. (Reproduced from *La Nature*.)

— Balbiani, professor at the Collége de France, was commissioned a short time ago, by the minister of agriculture, to report upon the best mode of destroying the winter eggs of the Phylloxera, as it has been found that it is in this way the progress of the parasite is very materially checked. Professor Balbiani reports that three methods have been employed, — the mechanical destruction of the eggs by barking the vines, boiling water, and rubbing the vines with preparations calculated to burn up the eggs. The first-named of these methods has been tried in several vineyards near Bordeaux, the workmen rubbing the stocks with a chain-steel glove; but the results are not satisfactory, as it is only the old wood which can be treated in this way. The use of boiling water would produce excellent results but for the fact that it is open, more than any other process, to carelessness in application; and that neutralizes all its good effects. The rubbing of the vines with a preparation composed of nine parts of coal-tar to one of oil was open to the objection that the coal-tar got so thick in cold weather that it could not be applied, and the cost of heating it again was considerable. Several vine-growers tried to liquefy the mixture by adding fifteen per cent of turpentine; but this, when applied, killed the vines altogether. Balbiani tried several fresh experiments, among others a mixture of oil, naphtha, quicklime, and water. This mixture has been tried upon a very large scale in the vineyards of the Lot-et-Garonne and the Loir-et-Cher; and it possesses, according to Balbiani, the double recommendation of being effectual and cheap, as the cost is under a franc for a hundred stocks.

— A Washington correspondent informs us that it was the Mohave and not the Zuñi women whom Dr. Tylor mentioned, at a recent meeting of the anthropological society of Washington (see *Science*, p. 448), as wearing bark skirts.

SCIENCE.

:DAY, NOVEMBER 21, 1884.

MMENT AND CRITICISM.

N hear it said, that any thing is easy n one only knows how; but the from doing to speculating involves **ly the** inverse of this; for what is **unending** conjecture to the wilfully **eorizer ?** Astronomers and physi**d with** powerful telescopes and spec**have** for years been assiduously **ith the careful** and systematic study **risible** phenomena of the solar disk, **een** able to obtain satisfactory solu**ny** problems of great difficulty. For **tious** pseudo-scientist, however, all **rs** have been in vain. His own **eclude** all need of investigation, and **ust** be manipulated into coincidence **agaries.** But there still remains a **steries** in the field of the physics of **which** all observation and reason**hesis** have so far failed to unravel. **harass** the soul of the pseudo- **Far** from it. Not only is he ready **every** occasion 'the true theory,' **ove** that his is 'the only possible **but he** rashly confronts all existing **th** unanswerable clinchers, in this **Vhere,** then, shall we turn for a **we** reject the one herein developed, *on-admission of which will forever ience in difficulties and inconsisten-*

e a doubt whether we do not owe our apology for space given up to such that noticed in another column of but it gives us excuse for correcting sion, more or less prevalent among rectly interested in the progress of science, that the crop of pseudo-iterature is larger in our own country abroad. The scientific 'crank,' like all of that ilk, is perpetually clamoring for recognition; and, as he ever and anon acts upon his belief that the acknowledged leaders in science are most easily accessible through their mails, this impression is speedily corrected on examination of the sources of the contents of a few waste-baskets. The more thorough and wide-spread scientific education afforded in many foreign countries is not apparently, as we should expect, the means of turning the energies of the 'crank' into the direction of legitimate research; but he enjoys his frequent appearance in type with a freedom which the American pseudo-scientist only rarely indulges.

We may take this occasion to comment further on the very unwise precedent which the publishers of this book have set by the issue of a work of this character. Book-publishing has for a number of years been conducted on a very scientific basis by a few of the better-known houses, and only such works have been issued as were able to pass muster with the critical 'reader' or expert. The greatest of care has been exercised, that the publication of no book should be undertaken the sales of which were not likely to be reasonably remunerative. Such care has greatly lessened the labors of large buyers of books, and inspired them with a very proper confidence in the best houses; so that, in fact, not a few libraries have standing orders with certain publishers for every book as soon as issued, and the book-buyer has heretofore been usually safe against serious imposition. When, however, an accumulation of literary refuse comes on the market, bearing the imprint of a reputable house, it becomes an appropriate season for the display of cautionary signals.

THE *Monthly weather-review* of the signal-service for last August shows an important

change in the right direction on its cover. Heretofore these valuable summaries, involving a great amount of labor quite apart from the preparation of daily forecasts, have been issued anonymously; at least, it has been simply announced that they were "prepared under the direction of . . . the chief signal-officer of the army." There is now very properly added to this the name of the officer personally in charge of the work. The more direct the statement of individual authorship, the better; for with it goes individual credit and responsibility. The 'Professional papers' and the 'Notes of the signal-service' have always been thus duly credited to their authors: it would be well if the authorship of the many circulars that have been issued on tornadoes, thunder-storms, and other subjects, had been as explicitly published.

THE TERMINOLOGY of storms adopted in these reviews is somewhat open to criticism. After forty years of observation, during which it has always been found that regions of low barometric pressure are accompanied by an inward flow of the winds, with a constant direction of spiral turning, it does not seem hasty to use a *name* for such phenomena, and call them briefly 'cyclones,' as was long ago suggested, so as to avoid the awkward paraphrase, 'area of low barometer,' on the one hand, and the abrupt slangy expression, 'low,' on the other, and do away with so erroneous a description as 'atmospheric depression,' and with so indefinite a term as 'disturbance.' It is an incorrect use of the word that associates cyclones only with hurricanes of devastating strength, or with local storms like tornadoes. It was originally proposed, and should still be used, to designate a certain kind of atmospheric mechanism, independent of gentleness or violence, and hence perfectly applicable to the 'disturbances' in question.

Redfield was clearly of this opinion. In 1854 he wrote that the term 'cyclone' was proposed "to designate any considerable area or extent of wind which exhibits a turning or revolving motion, without regard to its varying velocity, or to the different names which are often applied to such winds. . . . All hurricanes or violent storms may, perhaps, be considered as cyclones or revolving winds; but it by no means follows that all cyclones are either hurricanes, gales, or storms." He said, further, that the word was not designed to express the degree of activity or force of the wind, and made mention of "the inert and passive cyclones which seldom gain attention." Similar abstracts could be made from Col. Reid's famous work on the 'Law of storms;' and, even in the early numbers of the *Weather-review*, 'cyclone' was used in its original sense. It would be advisable to return to it.

BY MEANS of a most promising local anaesthetic, Dr. Koller of Vienna has recently been able to render the eye quite insensible to pain. Under its influence, almost any operation may be performed upon this delicate organ without causing suffering; and its use is not followed by unpleasant after-effects. A few minutes after putting three or four drops of a four-per-cent solution of hydrochlorate of cocaine into the eye, no discomfort is felt when the front of the eyeball is rubbed with the finger; or it may be cut with a knife, for example, to do an operation for cataract, and no pain is occasioned. It is not many weeks since this was demonstrated in Germany; and already many operations have been performed by our own oculists with great success and satisfaction. For some months before its use in the eye, it had been employed by physicians to render the mucous membranes less sensitive, especially that of the throat; and it will probably be found capable of rendering other valuable services in medicine.

The alkaloid cocaine, which was isolated about thirty years ago by Gardeke, and is somewhat similar to the one which is found in tea and coffee, is obtained from the leaves of the Erythroxylon coca. This shrub is cultivated in the valleys of the eastern slopes of

es; and its leaves, which are gathered d with great care, have been used by ves as a stimulant and narcotic since of the Incas, by whom it was held in teem. This plant should not be con- with the more familiar Theobroma he seeds of which afford chocolate and tter, nor with the cocoanut, whose pplies food, drink, light, clothing, lter to the natives of some tropical

ETTERS TO THE EDITOR.

ondents are requested to be as brief as possible. The ame is in all cases required as proof of good faith.

tone age in prehistoric archeology.

cent number of *Science*, it is stated (p. 438), meeting of the Academy of natural sciences elphia, Sept. 25, Dr. Brinton exhibited cer- e objects from Tunis, presented by the de Nadaillac. Among them was one re- the 'stemmed scrapers' found in this "This form," the writer goes on to state, acteristic, in France, of the *later* produc- he stone age, especially of that epoch called rench archeologists 'the epoch of Roben- Chronologically, this is regarded as the h of the appearance of man on the globe, ous implement-using animals being probably lds." This is a most amazing travesty of of de Mortillet and the archeologists of his It may safely be asserted that no one holds opinions as these, with the possible excep- e writer of the notice in question.

Prehistoric congress held at Brussels in briel de Mortillet first proposed his sys- assification of the age of stone. In it the och of Robenhausen' is given as synonymous of polished stone,' or 'neolithic period;' paleolithic age is subdivided into four grand called, in the inverse order of their anti- se of La Madelaine, of Solutré, of Moustier, t. Acheul, each characterized by its own ype of instrument. This classification was er extended by him to the age of bronze, in hibited at the Geographical congress held in the summer of 1875. A full account of en in the *Matériaux*, vol. x. p. 372. Since system has been almost universally adopted toric archeologists; and it is thoroughly and admirably illustrated in the 'Musée ique,' published by Messrs. Gabriel and e Mortillet, in 1881. In 1883 the elder de published, in the library of contemporary sci- 'Le préhistorique antiquité de l'homme.' he views he was known to hold in regard to led 'tertiary man,' or, as he more logically im, 'the precursor of man,' are set forth in critical notice of this work was given by r in *Science* for March 30, 1883. The work into three parts, — 'the tertiary man,' 'the y man,' and 'the man of the present' *ctuel*); and the doctrine is maintained that "it is only at *the commencement of the quaternary* that man shows himself not absolutely identical with us, but so near that we cannot refuse to him, under a proper nomenclature, the name of man" De Mortillet's peculiar views, with which only a very few anthropologists sympathize, are confined to the existence of an intelligent 'implement-using anthropoid' in tertiary times. To this question he returns with renewed vigor in his journal, *L'homme*, of the 25th of last September, apropos of the excavations made at the celebrated locality of Thenay (near Tours) by a committee of the French association for the advancement of science. These were preparatory to a discussion of the question of the tertiary man at the meeting held last year at Blois.

Whether it was 'man,' or 'an intelligent anthropoid,' who fabricated stone implements in tertiary times, may well be a question; but there is no doubt whatsoever that they were men very like those first found by Europeans on this continent, and Mr. Jacob Messikommer will help any one, as he did the writer, to disinter their relics from the peat-moor of Robenhausen. HENRY W. HAYNES.

Boston, Nov. 10.

Forgotten conclusions of science.

Your comments on the forgotten conclusion of an investigator on rectal anaesthesia reminds me of a discussion, in the section of physics at the American association, over a paper of Professor Graham Bell's, on a possible method of communication between ships at sea. Several eminent men and some distinguished foreign visitors took part in the discussion. It led out into suggestions of telegraphing across the ocean without wires, and experiments of communication across rivers, and across the strait between Southampton and the Isle of Wight.

As my recollection serves me, Professor Morse went over all these experiments more than thirty years ago, and supposed at one time he could carry his telegraph across rivers and streams by means of two wires, one running up and the other down stream along the shores, and then dipping into the water. I remember seeing a cut illustrating it. Professor Bell's paper was a new adaptation of the old idea; but the discussion, and all, seemed to me to be wholly oblivious of the experiments and conclusions of Professor Morse. P. J. FARNSWORTH.

Clinton, Io., Nov. 8.

The lamprey as a builder.

During the month of June I had an excellent opportunity to observe the manner in which the lamprey eel (Petromyzon marinus) builds a stone dam for the deposit of spawn and for the protection of the progeny.

The location of the structure was in the Saco River, within the ripples near the foot of the lower falls, three miles from the sea, and near the level of mean high water. It was nearly at right angles with a shore-wall of granite, and was about fifteen feet long and from one to three feet in height. Its position and triangular shape in vertical section were well adapted for securing a change of water, and a hiding-place among the stones for the young.

When I first noticed the movements of the eels, they were diligently at work, their system of operation being very methodical; but I was not able to determine whether there was any action by single pairs, as

their movements were rapid, and the number engaged at one time must have been fifty, while it is probable that a hundred were at work, for they were constantly coming from various directions to take or resume their places on the up-stream side of the dam.

The river-bed at this point was made up of water-worn stones, chips of granite, and fragments of bricks, over which there was a steady flow of water, the depth being four or five feet, but varying with the level of the tide.

The mode of raising the material was the same in all cases: the eel attached his mouth to a stone, and then, with many wrigglings and contortions (the head always pointing up-stream), lifted it from the bottom; he then backed down stream, floating with the current, until the stone was over the centre of the heap, when it was dropped, lodging sometimes on one side, and sometimes on the other. He then usually returned for more material to the deep and comparatively still pool formed above the dam by the previous excavations, but in some instances was unable to stem the more rapid current at the top of the dam, and was carried below it. When this happened, he swam around the outer end of the dam, and returned to the pool to resume the work.

I noticed in many instances that the heavier stones were lifted by two eels, working alongside of each other, and carried to their proper places in the structure. Half-bricks, weighing two pounds, were thus transported by one individual, and many of the stones were of much greater weight.

Later in the season many of the eels were lying quietly upon the up-stream side of the dam, and about the middle of July all had disappeared.

The temperature of the water, when the river-current was not met by the tide, was in June about 64° F., and in July 71°.

Stones of various sizes, lying at the base of the shore-wall, were removed; and it was evident that the stability of this wall would have been impaired if it had been built upon a rubble or gravel foundation instead of upon a solid ledge.

JOHN M. BATCHELDER.

Cambridge.

A viviparous pumpkin.

To-day, on cutting open a common pumpkin fresh from the field and perfectly sound, it was discovered that very many of the seeds had already germinated. The caulicles were from one to three inches in length, while some of the rootlets were over seven inches. The cotyledons, wherever free from the seed-covering, were green in color, and spread so as to expose the growing plumule. In one case the second leaves were partly unfolded. E. T. NELSON.

Delaware, O., Nov. 1.

American pearls.

In answer to George F. Kunz in No. 89, let me say that many pearls, ranging from five to twenty-five or more dollars in value, have been found in the fresh-water mussel in the Little Miami River, a few miles from here. The prevailing color is pink, in various shades. In size they vary, the larger ones being about as large as a pea, or larger. The pearls have been found at various times, from a dozen years ago, up to last April. They are commonly found in the Unio, — U. undulatus, or U. occidens. R. N. ROARK.

Nat. science dept., Normal university, Lebanon, O.

FERDINAND VON HOCHSTETTER.

FERDINAND VON HOCHSTETTER was born at Esslingen (Wurtemberg), April 30, 1829, and died, after a painful illness of five years, at Vienna, on the 17th of last July. His father, a clergyman, was a well-known botanist, and a professor of natural history. While a pupil of the celebrated geologist and paleontologist, Prof. F. A. Quensted of Tübingen, Hochstteter was a classmate of the late A. Oppel, and is one of the most prominent of the geologists of the school to which science is indebted for such celebrated geologists and paleontologists as Oscar Fraas of Stuttgart; C. Rominger of Ann Arbor, Mich.; A. Oppel, and Trautschold, of Moscow. When an assistant in the Austrian geological survey, he was appointed naturalist of the 'Novara expedition round the world,' 1857–59. After visiting Gibraltar, Rio de Janeiro, the Cape of Good Hope, St. Paul Island, the Nicobar Islands, and Java, Hochstetter left the Novara, shortly after its arrival at New Zealand, and passed almost the whole of 1859 in preparing a careful geological reconnoissance of the northern and southern islands of New Zealand. Scarcely had the Novara anchored at Auckland, before Julius von Haast, an Austrian nobleman of great ability, well known afterward as the director of the Canterbury museum of Christchurch, came on board. Haast had come out a short time before as a settler. Hochstetter at once secured him as his assistant; and after seven months in the northern island, and two months in the province of Nelson in the southern island, with the aid of the New-Zealand government and of the leading citizens of the colony, he succeeded in determining most satisfactorily the geology of this distant country, describing not only the beautiful volcanic formation, but also the secondary, the tertiary, and the quaternary formations, and adding much to our knowledge of geographical geology. The results of Hochstetter's researches were first given as lectures before the Auckland mechanics' institute, June, 1859, and at Nelson in October of the same year. The

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acked him, Hochstetter had the hap-
seeing all the collections removed to
building, and arranged so systemati-
the Vienna museum now ranks among
if not the first, in the world. From
872, Hochstetter was exploring Eu-
urkey, of which he prepared an excellent geological map, with a report. He afterwards visited the Ural Mountains, described in his 'Ueber den Ural,' Berlin, 1873. Hochstetter was also a geographer of note, and his 'Die erde' is justly popular. As vice-president, afterward president, of the geographical society of Vienna, he rendered important services to geography, more especially in assisting the expedition to the north pole, which resulted in the discovery of Franz-Josef Land, and in his continued aid to Dr. Oscar Lenz, the explorer of western Africa, and the traveller who made the remarkable journey from Tangier to Timbuctoo and the Senegal. Finally Hochstetter was selected, in 1872, by the emperor of Austria-Hungary as tutor in natural history to the crown prince.

Ferdinand v. Hochstetter

Personally, Ferdinand von Hochstetter was a most attractive man, a very interesting lecturer, and a powerful conversationalist. He married an English lady; and his house in Döbling, Vienna, was a centre for Austrian *savants*, and for all foreigners visiting the capital of the Austrian empire.

MARRIAGE LAW IN SAVAGERY.[1]

Society is organized for the regulation of conduct, and conduct is regulated by law in the

[1] See Certain principles of primitive law (*Science*, No. 92).

several stages of human progress in relation to those particulars about which serious disagreement arises. In the early history of mankind it appears, from all that we may now know of the matter, that the most serious and frequent disagreements arose out of the relations of the sexes. Men disagreed about women, and women about men. Early law, therefore, deals to a large extent with the relations of the sexes. The savage legislator sought to avoid controversy by regulating marital relations; and this he did by denying to the individual the right of choice, and providing that certain groups of men should take their wives from certain groups of women, and, further, that the selection of the woman should not be given to the man, nor the selection of the man to the woman, but that certain officers or elder persons should make the marriage contract. This method of selection will here be called legal appointment.

Now, selection by legal appointment exists among all North-American tribes, and elsewhere among savages in Australia and other portions of the globe: it exists in diverse forms, which may not here be recounted for want of space. But the essential principle is this: in order that controversy may be avoided, marriage selection is by legal appointment, and not by personal choice.

But the second fundamental principle of primitive law greatly modifies selection by legal appointment, and gives rise to three forms of marriage, which will be denominated as follows: first, marriage by elopement; second, marriage by capture; third, marriage by duel.

It very often happens in the history of tribes that certain of the kinship groups diminish in number, while others increase. A group of men may greatly increase in number, while the group of women from whom they are obliged to accept their wives diminishes. At the same time another group of women may be large in proportion to the group of men to whom they are destined. Under these circumstances, certain men have a right to many wives, while others have a right to but few. It is very natural that young men and young women should sometimes rebel against the law, and elope with each other. Now, a fundamental principle of early law is that controversy must end; and such termination is secured by a curious provision found among many, perhaps all, tribes. A day is established, sometimes once a moon, but usually once a year, at which certain classes of offences are forgiven. If, then, a runaway couple can escape to the forest, and live by themselves until the day of forgiveness, they may return to the tribe, and live in peace. Marriage by this form exists in many of the tribes of North America.

Again: the group of men whose marriage rights are curtailed by diminution of the stock into which they may marry, sometimes unite to capture a wife for one of their number from some other group. It must be distinctly understood that this capture is not from an alien tribe, but always from a group within the same tribe. The attempt at capture is resisted, and a conflict ensues. If the capture is successful, the marriage is thereafter considered legal; if unsuccessful, a second resort to capture in the particular case is not permitted, for controversy must end. When women are taken in war from alien tribes, they must be adopted into some clan within the capturing tribe, in order that they may become wives of the men of the tribe. When this is done, the captured women become by legal appointment the wives of men in the group having marital rights in the clan which has adopted them.

The third form is marriage by duel. When a young woman comes to marriageable age, it may happen that by legal appointment she is assigned to a man who already has a wife, while there may be some other young man in the tribe who is without a wife, because there is none for him in the group within which he may marry. It is then the right of the latter to challenge to combat the man who is entitled to more than one, and, if successful, he wins the woman; and by savage law controversy must then end.

All three of these forms are observed among the tribes of North America; and they are methods by which selection by legal appointment is developed into selection by personal choice. Sometimes these latter forms largely prevail; and they come to be regulated more and more, until at last they become mere forms, and personal choice prevails.

When personal choice thus prevails, the old regulation that a man may not marry within his own group still exists; and selection within that group is incest, which is always punished with great severity. The group of persons within which marriage is incest, is always a highly artificial group: hence, in early society, incest laws do not recognize physiologic conditions, but only social conditions.

The above outline will make clear the following statement, that endogamy and exogamy, as originally defined by McLennan, do not exist. Every savage man is exogamous with relation to the class or clan to which he may

[...], and he is to a certain extent endog[...] in relation to the tribe to which he [...]gs, that is, he must marry within that [...] but in all cases, if his marriage is the [...] of legal appointment, he is greatly re[...]d in his marriage rights, and the selec[...]ust be made within some limited group. [...]my and endogamy, as thus defined, are [...]al parts of the same law, and the tribes [...]nkind cannot be classed in two great [...]s, one practising endogamy, and the [...] exogamy.

[...] law of exogamy is universal. Among [...]ples there is a group, larger or smaller, [...]tural or artificial, within which marriage [...]hibited. The terms 'exogamy' and [...]gamy' are misleading, and should be [...]ded.

J. W. POWELL.

[...] SCIENTIFIC STUDY OF LAWN-TENNIS.

[...]N-TENNIS is a game which has taken firm [...]pon Americans, and is becoming more [...]r every year. It is claimed to possess [...]alities which make a perfect game, being [...]healthful, not insuperably difficult, and [...]interesting to 'duffer' and expert, pro[...] the two are not matched. The use of [...]ut' and of slow returns having been [...] up for drives, volleying, and swift [...]s, it has ceased to possess the reproach [...]ast upon it of being a ladies' game, and [...]itted to call forth science, skill, and [...]nce. Lawn-tennis puts upon its players [...]and for muscular quickness and elasticity, [...]self-control, and a fine and peculiar de[...]nent of the muscular sense.

[...]s by the help of this sense that the ball [...]rned with just the right force and in [...]e right direction, no matter how hard [...]r gently it strikes the bat; and in ten[...] peculiarity lies in the fact that delicate [...]lar adjustments must be made at the [...] time that violent contractions of the [...]s take place. The skilled artisan goes [...] and gently over his delicate work. [...]juggler performs his tricks with light [...]asily handled articles. The billiard-[...] has to use comparatively little force [...]ke his brilliant strokes. The tennis-[...], however, must be ready to strike hard [...]ly while gripping the racket, adjusting it [...] the right angle, and driving it in just [...]ht direction.

[...] experiences a curious sensation of pleas[...] thus developing and exercising his muscular sense. The delight felt over a good shot, a brilliant catch, an unexpected return, — all come in the main from this same source, which we might almost call the 'sporting sense.'

The physiology of muscular co-ordination has been much studied, but its relation to aesthetics is, perhaps, not as yet 'worked up:' therefore I will dwell upon this point a little.

Every phase and degree of muscular contraction registers itself in the brain; but when these contractions, in obedience to the will, effect a certain delicate, previously conceived result, a thrill of pleasure is felt, which is not wholly mental satisfaction over success; it is also an intensified muscular sensation. As the eye delights in beautiful colors, and the ear in sweet music, so the muscles rejoice in delicate adjustments. They have their own æsthetics: hence there have always been athletic sports, and hence even pugilism would have no charm if it were mere slugging.[1] The Greeks cultivated this sense as actively as that for poetry, sculpture, and architecture: we might do well to imitate them.

It is true that the muscular sense is not the only factor in measuring distance and adjusting muscular movements. The eye, the ear, and the tactile, more especially the pressure, sense, also come into play. But setting aside the zest of competition, the joys and sorrows of beating or being beaten, it is to certain sensory nerves, distributed through muscle and tendon, that we must attribute much of the pleasure got from athletic games. This may be shown in still another way. After the frequent repetition of a set of muscular contractions, the sensations excited thereby cease to rise into consciousness. Perhaps this is due, as Ribot suggests, in part to their increased number, and briefness of duration. At any rate, we know that a frequently repeated act of muscular skill finally comes to be done almost automatically and with little intervention of consciousness. So it is that with skilled players the minor and easy strokes of the game call out no new, complex, and delicate adjustments with the corresponding aesthetic excitement.

Every one who has ever attained any special skill in athletic games knows the pain and weariness of playing with the beginner. What hours of heroism in love's cause have been spent by old tennis-players in teaching the non-

[1] I am quite aware that some physiologists consider part of the muscular sensations to be central in origin (innervation feelings), starting up with the volitional impulse, and accompanying it, as it were, to the muscle. It is simply inconceivable, however, that we can be conscious of muscular contractions that have not yet been made.

co-ordinated musculature of fair young maidens to serve and return the ball! The reason is plain enough to the player; but, put in physiological terms, it supports the view I have suggested as to the aesthetic function of the muscular sense.

The muscular mass of the human system is a large one. It makes up forty per cent of the total bodily weight; and leaving out the skeleton, which has a mechanical function only, we are two-thirds muscle. Besides, it is supplied throughout with the nerves which excite it, and with sensory nerves, which notify the brain at once of use and misuse, sickness and health. There may be a fair state of health, but there can be no exuberant vigor, none of the lusty *joie de vie*, without perfectly nourished and perfectly functioning muscles. Thus, when over-used or poorly nourished, we have the sensations of fatigue, weariness, and *malaise*, such as are complained of by thousands of underfed and underworked persons. Furthermore, as the muscle retires, the nerve comes to the front, and we get our nervous women, who are the products, in large part, of insufficient or improper muscular exercise.

There are a few pathological facts in connection with lawn-tennis which may be briefly noted: —

Every new invention and every new sport has its accidents and diseases. For some time English medical journals have had letters about 'lawn-tennis arm,' 'lawn-tennis elbow,' and 'lawn-tennis leg.' The cause of these troubles is generally simple. 'Tennis arm' is caused by a rupture of some of the fibres of the *pronator radii teres*. The front of the fore-arm is tender, perhaps swollen, while pronation and flexion are difficult. In some forms of 'tennis arm' the musculo-spiral nerve, as it passes around the elbow, gets pinched and injured; then there is weakness in extension and in 'back-hand' strokes. In 'lawn-tennis wrist' the anterior part of the annular ligament is stretched, and there is probably a little inflammation of the grooves in which the flexor tendons run.

'Lawn-tennis leg' is due to rupture of some of the muscles of the calf in swift and powerful serving. The muscle ruptured is thought to be the *plantaris longus*.

These 'legs' and 'arms' are more apt to occur in middle age and among too ambitious beginners. They are not of frequent occurrence, and are not dangerous. Rest, rubber bandages, friction, and electricity are sure to bring about a cure. C. L. DANA, M.D.

New York.

LATE NEWS FROM THE NORTH-WEST.

LATE advices from Alaska state that the volcano on Augustine Island, Cook's Inlet, continues to show signs of activity by smoke, noises, and earthquake shocks of light intensity. About the time of the eruption last autumn, between the 23d of September and the 18th of October, eight shocks were felt at Port Etches, in Prince William Sound. At Kassiloff, on the eastern shore of Cook's Inlet, at the mouth of the river of the same name, on the 14th of November, 1883, a tidal wave flooded the salmon-canning establishment of Cutting & Co., and washed away a considerable strip of bluff along the shore for several miles.

Edward Langtry, one of the early explorers of the Lewis branch of the Yukon, in the Chilkat country, has been prospecting on the Kuskokwim and Nushagak Rivers during the past year, and intends to remain another season.

News from the explorers of the Copper or Atna River indicates that they were in July detained at a point where the river passes through a narrow cañon, and a glacier abuts upon it. This glacier, extending over the surface of the stream, nearly closed it to navigation, and an arrangement had just been completed with some of the natives, who were to assist the party to cross the glacier.

News has been received of the return of Lieut. Stoney from his explorations on the Kowak River, emptying into Hotham Inlet, Kotzebue Sound. He had ascended this river, which has been known for thirty years, but never surveyed, to a distance which he estimates at four hundred miles, which is probably meant to include all irregularities. He did not reach its source, as his instructions forbade him to winter there. He has forwarded a report to the Navy department. A party from the revenue-steamer Corwin has also ascended the river this season, and in 1881–82 Messrs. Jacobsen and Woolfe explored its course for some fifty miles. The former has just published at Leipzig an account of the journey under the editorial supervision of Dr. Woldt, a work which has not reached us. The following year Lieut. Stoney, furnished with a boat and party from the revenue-steamer Corwin, Capt. Healy, on which he was a passenger, made some praiseworthy investigations at the mouth of the Kowak and the entrance of Hotham Inlet. These gave rise to some unfounded reports in the daily press that the river was a new discovery. The extent of the stream, leaving minor curves out of account, cannot much exceed two hundred and fifty geographical miles; but it runs through an almost unknown region, and the official reports will, no doubt, add materially to the geographical knowledge of that part of Alaska.

A trading-post has been established at Yakutat Bay by the Alaska commercial company, — the first which has existed there since the destruction by the Indians of the old Russian settlement of 'New Russia' about eighty years ago. The natives have always been treacherous and unreliable. The establishment will be conveniently situated for any adven-

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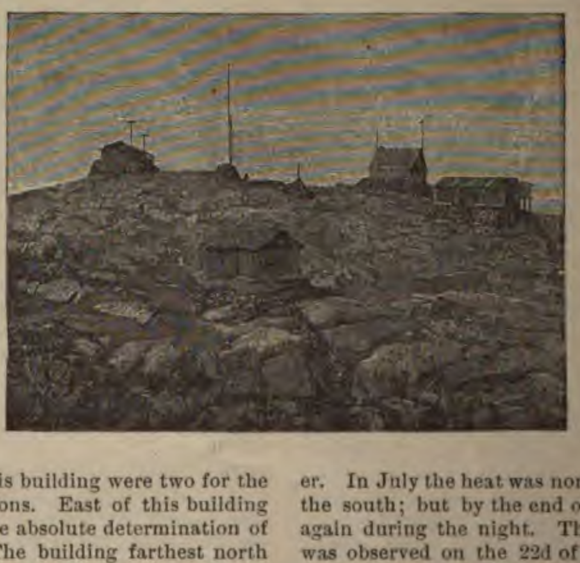
One other advantage, available in all these systems

In glacial times the mountain plants of the arctic zone descended to the valleys, and were distributed with the glaciers toward the south. That this migration radiated from the north is shown by the fact that not only do arctic species form almost half of the plants in the snowy region of the Alps; but also the mountains of America, as well as of the Altai and Himalayas, possess a large number of arctic forms common also to the Swiss Alps. It is known that in the tertiary and in the upper cretaceous periods a number of species can be traced from Greenland as far as Nebraska in America, and as far as Bohemia and Moravia and southern Europe on the other side. Similarly in the cretaceous period, in the tertiary, and at the present time, Europe and North America have in common a number of species which also existed at that time in the arctic zone, and very evidently had their origin there; and hence the flora of the far north has at all times exerted a great influence on that of Europe.

The endemic flora of the nival region originated in the Alps, especially in the Monte Rosa chain. It possessed its present features at the beginning of the quaternary, and was distributed by means of the glaciers into the valleys and the neighboring mountain regions.

THE DANISH INTERNATIONAL POLAR STATION.

THE Danish polar station was at Godthaab, Greenland, — a little colony situated at the extremity of a peninsula which separates the two large parallel fiords, of Godthaab, and that, farther south, of Ameralik. The station was erected on a little hill of almost pure gneiss, twenty-six metres above the level of the surrounding water. This place was chosen both because it was the highest elevation in the immediate neighborhood and because the gneiss appeared free from iron ores.



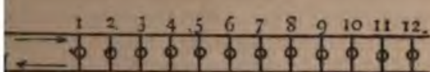
There were, in all, five buildings. The one farthest to the south had two apartments, of which that to the east contained the telescope and the astronomical apparatus. In the other room were a Robinson anemometer and a recording anemoscope. North-east of this building were two for the study of magnetic variations. East of this building was a smaller one for the absolute determination of terrestrial magnetism. The building farthest north was the office; and there the barometers and the Hagemann anemometer were placed, as well as a Mascart electrometer. Besides these, there was in the open space a Wild shelter, covering the thermometers to determine the temperature and humidity of the air, a delicate hygrometer, and a Wild evaporimeter. Three thermometers were placed vertically in holes in the rock, at depths of sixteen, thirty-one, and sixty-three centimetres. At the edge of the holes were small iron pipes to prevent infiltration. The thermometers were sheathed in wooden rods having the same diameter as the holes. At the bottom of each hole was a little mercury, which could penetrate to the thermometer-bulbs through perforations made in the lower part of the rods. Behind the shelter of the thermometers were placed two thermometers whose bulbs were buried fifteen and thirty-seven centimetres respectively beneath the surface of the ground. At some distance from the foot of the hill, two Hamberg thermometers were placed at depths of one metre and one and five-tenths metres. Besides the proposed observations, the parallaxes of a large number of auroras were measured, the electricity of the air was studied, and the temperature of the rocks, the soil, and the water of the fiord, noted.

In the early part of the autumn of 1882 the weather was comparatively mild, south winds prevailing. It was not till the last of September that it was cold enough for a slight frost; but the weather again moderated under the influence of the south winds, which lasted until the first days of October. From the 11th of October the cold was maintained, almost without interruption, until the 5th of March, 1883. During all that interval the thermometer remained constantly below 0° C., except for some isolated days, and then only for a short time. From the 23d of January to the 13th of February the cold was the most intense and persistent; so that even the south winds, and the very low barometrical pressure during that period, were powerless to produce a change. The greatest cold was observed on the 9th of February, with 24°.4 upon a slight elevation; but at the same time it was found to be 26°.7 in the low lands. During the first part of March the cold became again very severe; but after the 5th of the month the weather moderated, and became more variable. It was only after the middle of June that the weather grew milder. In July the heat was normal, and the winds from the south; but by the end of August frost appeared again during the night. The greatest heat of 14°.5 was observed on the 22d of June, during a tempest from the south, at the same time that the thermometer on the low lands attained 17° C.

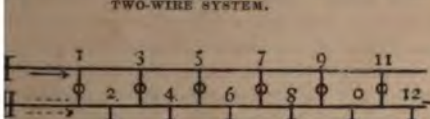
SON'S THREE-WIRE SYSTEM OF DISTRIBUTION.

three-wire or multiplex system of distribut-rents for electric lighting over large areas, sed and used by Edison, is highly ingenious, ective in reducing the necessary size of the pper conductors. The size of the conductor e proportioned to the maximum number of which it will ordinarily supply. This number ven, the size should be such that the resist-the metallic part shall bear a fixed ratio to the lamp part of the circuit; and the value of o will be determined by the condition that the al running expense due to the resistance of ductor shall equal the interest on its first far as this depends upon its cross-section.

e two-wire system, A is the dynamo, which suppose to keep up a difference of potential ndred volts between the conductors I and ross these are bridged twelve lamps of equal ce, representing what would be, in practice, hundred dwellings, factories, churches, thea-.



TWO-WIRE SYSTEM.



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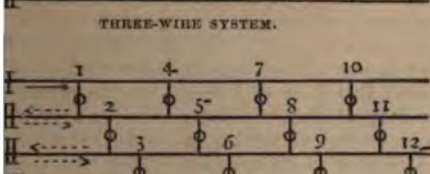

FOUR-WIRE SYSTEM.

ext figure shows Edison's three-wire modi-of this. A and B are two dynamos coupled , with conductors I, II, and III leading own. As A and B each keep up a hundred before, the difference of potential between II will be two hundred volts. The twelve re now, however, equally divided between its I-II and II-III, connected as shown. sistance of the six odd-numbered lamps, 1–11, quals that of the six even-numbered, 2–12, and B keep up the same difference of , no current will flow in II, between the and where the first lamp joins it. Suppose cut, there will then be a single circuit A and B, I and III, and the twelve lamps, , with a difference of two hundred volts in I The resistance of the twelve lamps, as nged, will be four times what it was before; and hence only one-half as much current will flow through I and III. But each of the lamps will get just as much as before, and will shine the same. The conductors I and III, since the resistance is now four times as great, need only be one-fourth as heavy, according to our adopted principle. This is also proper as regards heating-effect in them, which, proportional to the square of the current, is now only one-fourth what it was before.

If this were all that was needed, we should now have the same amount of lighting done, and the conducting-mains, which are the most expensive part of the plant, of only one-fourth their size and cost in the two-wire system, and with only the additional expense of another dynamo. Moreover, since the current is only one-half as much, these two dynamos, though giving the same potential as before, can be smaller. But on account of the difficulty in keeping an exact balance in the two sets of lamps, especially about the time of lighting up at twilight, it is necessary to introduce the third conductor from between the two dynamos, and then neither circuit can be exposed to a difference of potential greater than either dynamo is generating. Also, if the balance is not kept, a current through II, and a galvanometer, shows on which side the lamp-resistance or the dynamo-potential is in excess; and Edison restores the balance by variable resistances in the circuits of the field-magnets, or, in some cases, by bringing an extra conductor from one or two large buildings, like factories, theatres, etc., when near by, so that they can, at will, be thrown into either circuit from the central station.

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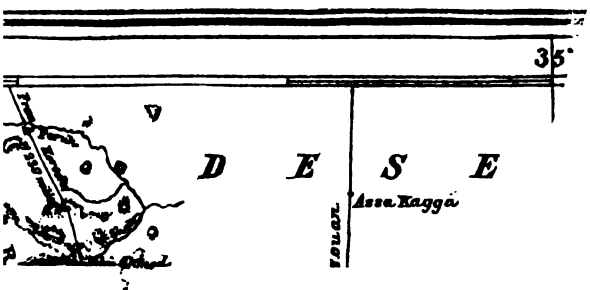

35°
D E S E
Assa Kagga

cing to the safety of his hypotheses, are cast aside; as, for example, the well-known work of Carrington on the solar spots, "for the sun was an especial study with him [the author] before Mr. Carrington was born, and he prefers his own approximations" (p. 30).

It is not, however, so hard to see how an ill-balanced enthusiast may persist in this course indefinitely, as it is difficult to conceive of the intellectual stupefaction which busies itself with the preposterous invention of suitable facts to match agreeable hypotheses. When, for example, Mr. Bassnett finds his theory of ethereal vortices cannot help going to pieces when he tries to make it account for the observed phenomena of the periodicity of the solar spots, he has no hesitation in fabricating a great planet outside of Neptune, of such mass, and position, and distance from the sun, as to bring about the absolute harmony of his hypothesis with the observed periodicity; nor does he shrink, when he finds it necessary, to make this convenient planet travel round the sun in just the other way from what all the hitherto recognized planets do.

But unaccountable idiocy can be tolerated where unconscionable conceit cannot. When the world's greatest investigators of solar phenomena confess that the sun and its surroundings are the mystery of cosmical physics, this writer pops into prominent print with a book "whose credentials are an undeniable ability to divest that subject of its mystery." Sun-spots, to say the least, have yielded all their secrets to him; and he retires from an excursion of half a hundred pages on his own theory of the solar spots with a self-complacency more alarming than a thousand eurekas, for he finds that "the solar spots are not such formidable mysteries, after all" (p. 172).

The gross failure of the author's life as a scientific man appears to lie, just where many lives make shipwreck, in his early penetration with the idea that his destiny was with the great. It was for others to drudge in collecting facts, but for him to cut a grand figure in the development of striking and original generalizations,— an unhappy fallacy of ill-balanced minds. 'Our business,' he says, 'is to establish a *theory*.' etc.; and later (p. 129) we are told that "in 1853 the author published the only possible solution of the problem [of sun-spot periodicity]." The persistent refusal of scientific men to recognize his arrogant claims leads him to indulge a vindictive insolence. His experience of the treatment which his theory of electric vortices has received during the past thirty years is a sorry one, and encourages occasional despondency, and the "growing conviction that the scientific world, as a body, loves darkness rather than light." However, he falters not; for it is better to "have the approval of a few kindred spirits, than drift with the current which is sweeping a deluded majority to inevitable oblivion."

How long ought the patience of scientific men to indulge this badgering assumption? Mr. Bassnett has repeatedly addressed himself to the acknowledged leaders in science, and has been just as repeatedly snubbed. At various scientific assemblies he and his ubiquitous electric vortices have been the dread of presiding officers, and the butt of 'Section A.' So far, however, from inculcating the necessity of humility, all these merited rebuffs have only emboldened him to renewed impertinence, which he has the effrontery to term 'scientific spirit.'

A book so nearly valueless we have rarely seen. A single chapter, however, — that on the ethereal medium, — is worth the reading: it is suggestive as to lines of research which may some time come to be worth following out; and the vigorous statements of the author's beliefs are an interesting study. But as a whole, little good, if any, can come from the printing of such a volume; and with equal certainty the harm it can do is a minimum, for its readers will be few, and chiefly confined to such of the curious as know too much to be led astray.

THE VALUE OF SORGHUM.

Sorghum: its culture and manufacture economically considered as a source of sugar, syrup, and fodder. By Peter Collier, Ph.D., late chemist of the U. S. department of agriculture. Cincinnati, *Clarke*, 1884. 11+570 p., illustr. 8°.

Although the cultivation of sorghum in the United States, and its utilization as a source of sirup, date from about the middle of this century, and although more or less frequent attempts to produce sugar from it had been made at the time when the U. S. department of agriculture began its investigations (1878), the most conflicting opinions prevailed as to the value of the plant as a source of sugar. The remarkable growth of the sorghum-sugar industry within the last few years, and the very general interest in the subject now manifested, may be fairly ascribed mainly to those investigations, and to others which were incited by them.

It is a matter of congratulation, that the task of recording the results of recent inves-

tigation and experience in this important subject in permanent and accessible form has been assumed by one so competent as the late chemist of the department of agriculture, under whose direction or at whose instigation so much of the work has been done. Dr. Collier's scientific standing, and his thorough knowledge of the sorghum question, will hardly be doubted; and, if at times he betrays the sanguine temper of the enthusiast, the failing is one which leans to virtue's side.

In the book before us we have a very full account of the history of sorghum; a description of its leading varieties, including a table for their identification; and the result of the experience thus far had, relative to the management of the crop and its profitable manufacture. The preparation and manuring of the ground; the selection of suitable varieties; the best methods of planting, cultivating, and harvesting; the effects of climatic conditions; the development of sugar in the plant as related to the proper time for cutting the cane; the operations of milling, defecating, evaporation of the juice, and separation of the sugar; and the utilization of the waste products, — all receive a due share of attention; and the whole constitutes an excellent handbook for the intelligent sugar-maker.

The book, however, is more than a sugar-maker's handbook. One of the most commendable features of the work is the fulness with which the evidence upon each point in turn is laid before the reader, thus enabling him to judge for himself of the value of the conclusions reached. This feature of the volume cannot fail to make it of great value to all who are engaged in investigations in this direction; for, not only are the results thus far obtained given with much fulness, but the author is as careful to exhibit our ignorance as our knowledge, and does not fail to point out the directions in which further investigations are needful.

That the latter are numerous need hardly be said. In spite of the great amount of work which this book records, or refers to, much yet remains to be done to render this industry an assured success. Indeed, to us the need of more knowledge is really the most striking conclusion to be drawn from a study of what is already known. Particularly is this the case with regard to the economies of sugar-making, where a wide field is open to investigation. If Dr. Collier's volume shall prove an incitement and aid to the acquisition of more light upon these and other points, as well as be of use to the practical sugar-maker, he may account it as in the best sense a success.

NOTES AND NEWS.

THE library of the late Professor Henry has been purchased from his heirs by Dr. A. Graham Bell. It contains about two thousand volumes, at least one-third of which treat of electrical science, and many of these bear marginal notes in the handwriting of Professor Henry. One of the terms of the sale was that the library should be kept intact.

— The Norwegian bark Loveid, recently arrived in Philadelphia, reports a very peculiar squall experienced Oct. 18, in latitude 39° 49′ north, longitude 69° 5′ west. During fine, clear weather, with a light breeze from the north-west, heavy banks of clouds of most threatening aspect suddenly appeared, driving in every direction. Almost immediately a heavy squall of wind and rain struck the vessel, the wind shifting quickly all around the compass. In the midst of this disturbance, which lasted about an hour, a single peal of thunder was heard, and simultaneously a bolt of lightning struck the fore royal mast-head, and ran down the mast to the royal yard, which was almost destroyed. The lightning, which looked like a ball of fire, then ran out on the horn of the cross-trees, and 'burst' with a loud report, scattering sparks all over the vessel. The barometer fell suddenly from 30 to 28.60, and then rose as rapidly, the weather becoming pleasant immediately afterwards. This is a rather peculiar squall, considering the locality and the season.

— The monthly weather-review of the signal-service, prepared, as announced for the first time in the August number, by Second Lieut. W. A. Glassford, has come to be a quarto of twenty-eight pages, with five charts. This is a good growth from the four small pages and three charts of the first issue, eleven years ago. Then, the headings were storms, anti-cyclonic areas, temperature, precipitation, peculiar phenomena and facts, rivers, and cautionary signals: now, all these subjects are treated in much greater detail; and among the many additional topics there may be mentioned atmospheric pressure and its range (illustrated by a new style of chart), Atlantic storms and ice, range of temperature, frosts (illustrated by a chart for Aug. 9 and 25), winds, local storms, tornadoes and thunder-storms, sunsets, drought, two and a half pages on the earthquake of Aug. 10, meteors, and notes of state weather-services for Alabama, Nebraska, Tennessee, Missouri, Louisiana, Ohio, and Georgia. The storm-tracks for the month are remarkably regular, and, with insignificant exceptions, all lie north of the Great Lakes and St. Lawrence: no tropical cyclones were felt along the seacoast. Nine tornadoes are reported, and many violent thunder-storms. Some of the results of the special studies of the latter, undertaken by Mr. H. A. Hazen during the past season, take form in a brief summary, from which it appears that the mean distance and direction of the nine hundred thunder-storms recorded in August, from the centre of the broad cyclonic storms in which they occurred, was five hundred and fifteen miles, a little west of south. A full account of these studies will be of much value

est. Most of the observations on meteors nall value; and, at best, they have but an ical connection with a weather-review.

fish-commission steamer Albatross will winter in the Gulf of Mexico. A special l be made of the waters in and about Mo- where, during the past few years, a strange t unknown malady has poisoned the fish so ler them unfit for food; but the larger part uise is to be spent along the coast of Texas siana.

ENT WITH THE AEROPLANE MADE AT THE FRENCH MILITARY EXPERIMENT-STATION OF CHALAIS-MEUDON IN 1879. (*La Nature.*)

announcement is made, that copies in bronze t of the late J. B. Dumas of Paris, may be by subscription, addressed to the adminis- f the Génie civil, Paris. The original bust uted by Guillaume, of the Institut, and was ed highly satisfactory. The prices range y francs to six hundred francs, according to quality of the bronze.

lloxera has made its appearance in the Pomo- stitute of Proskau (Silesia). It is hoped, that the spread of the disease may yet be l.

next meeting of the Society of naturalists stern United States will be held at Wash- ring the week following Christmas, 1884. The exact days and place of meeting will be announced later. Titles of papers to be read, and nominations of candidates for election, should be sent to the secretary at once.

— Bulletin No. 5 of the U. S. geological survey is a dictionary of altitudes in the United States, compiled by Henry Gannett, chief geographer of the survey. It is essentially an extension of the 'Lists of elevations,' prepared by the same author for Hayden's survey; but, with the present broader organization of the geological survey, the lists now appropriately include the whole country, while the earlier editions were concerned chiefly with the region west of the Mississippi. A list of authorities fills eight pages, and railroad abbreviations occupy eight more; then the states and stations follow alphabetically, the number of altitudes given being about eighteen thousand. It is stated that the collection of railroad profiles for Pennsylvania is exceptionally complete and admirably adjusted, making the portion of the dictionary referring to that state by far the fullest and most satisfactory. By apparent oversight, it is not stated whether the base level is high, mean, or low tide.

— Two volumes of the addresses and speeches of Helmholtz have just been published in Germany.

A third edition of his well-known volume, entitled 'Popular scientific addresses,' having been called for, the author seized the opportunity to complete the collections, and in doing so has dropped the word 'popular,' although the earlier and later papers are alike designed to bring the results of mathematical, physical, and other scientific researches, before a circle of hearers and readers whose studies do not run in that direction. Among other papers, the volumes contain Helmholtz's prefaces to the German edition of Thomson and Tait's 'Natural philosophy,' and of Tyndall's 'Fragments of science,' and also his academic discourses. Among other noteworthy papers is an address on electrical units in reference to the action of the Electrical congress at Paris in 1881. This address, which was given in Berlin in December of that year, was reported, at the time of its delivery, stenographically, and has now been revised, and supplemented by a statement of the conclusions of the conference of 1884.

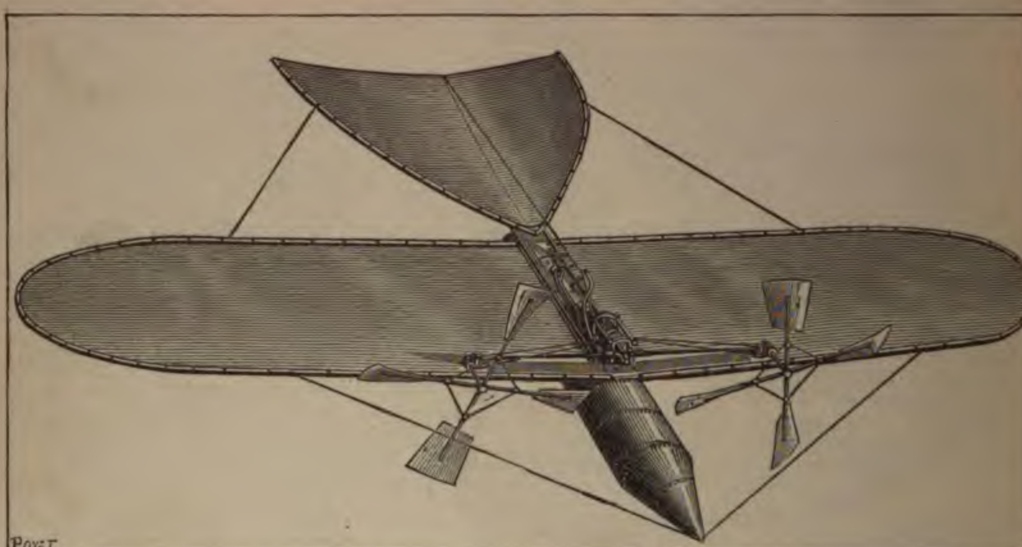
— Professor Valentine Ball of Dublin writes to *Nature*, lamenting the few copies of the English government scientific reports which are gratuitously distributed in the United States. He states, that although from a feeling of shame he did not seek to gather statistics, he found from casual conversation that a great many of the American libraries were obliged to purchase such reports as those of the various English surveys and the Challenger expedition. He praises the lavishness of our own government bureaus and the work of the Smithsonian in the distribution of printed matter, and expresses a hope that some similar free bureau of exchange may be established in England.

— Prof. F. Braun, formerly at the Polytechnikum in Carlsruhe, has been called to the professorship of physics at Tübingen. Dr. O. Lüdecke has been appointed professor in the philosophical faculty in the university at Halle.

— The German association of naturalists has selected Strassburg for its next year's assembly.

— The completion of the Lick observatory now depends upon the successful making of the disk of glass for the objective of the large telescope. The main dome cannot be made till the focal length of the large equatorial has been determined.

— The success of the flying-machine invented by Renard and Krebs has called attention to a partially successful experiment tried at the military experiment-station at Chalais-Meudon in 1879. The construction of the machine, an invention of Victor Tatin, is pictured in a general way above. It consisted of a cylindrical receiver for compressed air, which was used to drive two air-propellers. The weight of the whole was supported by the pressure of the air against the under sides of the laterally extended wings, the forward edges of which were kept inclined slightly up by the steering-action of the tail. The total weight of the apparatus, as tried, was 1.75 kilograms, and the velocity obtained, about 8 metres per second. The machine was able to rise from the ground; and, attached by a cord to a post, it flew around in a circle, passing over the head of the spectator (see p. 481). Mr. Tatin sent a description of his experiments to the French académie des sciences, in competition for the Perraud prize, and received a reward, as did Gaston Tissandier for his experiments on the application of electricity to aeronautics, and Duroy de Bruignac for his *aérophone mixte*.



AEROPLANE INVENTED BY VICTOR TATIN. (*La Nature*.)

SCIENCE.

RIDAY, NOVEMBER 28, 1884.

MMENT AND CRITICISM.

RIMARY work of our Hydrographic of-
publication of charts, based on origi-
ys of distant coasts, by officers of our
t at present we take only a small part
rm of maritime exploration. During
year, only one vessel has been en-
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tercourse has been greatly increased
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material is obtained. The demand for
chart of the North Atlantic (see *Sci-*
69) has steadily increased; and some
have even telegraphed from Europe,
own expense, certain observations of
terest, made on the voyage across, for
on on it. The distribution of blank
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than doubled during the past year;
masters have been stimulated to make immediate report of inaccuracies of charts, and matter of all kinds pertinent to hydrography and cartography.

AMERICANS are often called upon to contribute toward memorial funds which are designed to honor distinguished Europeans. Among recent requests of this sort, we remember the subscriptions which were opened in honor of Berkeley, the early friend of education in this country; Tyndall the reformer; Charles Darwin; and the naturalists Balfour, Barrande, and Müller, — every one of whom is well worthy of high honor from Americans as well as from Europeans. Probably the amount which has been raised for all these commemorations is quite moderate, constituting no adequate expression of American sentiments, and no important part of the entire sum collected. The value of the gift is doubtless in the international or cosmopolitan aspect which it imparts to the memorial. But it is quite possible that each of these tributes has taxed some one in this country to a very considerable extent. Committees have been formed, circulars distributed, small sums collected, and a good deal of correspondence exchanged; and all this with very slight results. We raise the question whether it is worth while to make such efforts? Is the return worth the exertion? The truth is, in our opinion, that what force we can command in the direction of monuments ought to be expended in memorials to be retained in this country. Among secondary educational influences, monuments to great men hold a most important place. They not only honor the departed: they inspire the enthusiasm of youth, they encourage lofty emulations, they lead all classes to think about the men who have contributed to the advancement of our civilization.

We are only at the beginning of the monumental epoch in this country. Having honored

soldiers and statesmen for many decades, the Americans now seem ready to commemorate their literary and scientific heroes. John Harvard and Abraham Pierson, whose real likenesses perished long ago, have risen in bronze upon the greens at Cambridge and New Haven. The statues of Joseph Henry and Benjamin Silliman stand near the scenes of their activity. Examples like these should be imitated throughout the land. Those who have rendered great services to science and education should receive due recognition from those who have profited by their labors. Only let us pray to be spared such commonplace monuments as are to be seen in abundance in London. Let us rather study the memorial statues which have of late years been placed in the cities of Germany, Holland, France, and other continental countries. Better no monuments than those which give positive pain to the beholders, and which will some day be lowered, like the Iron Duke from his lofty arch, when taste and skill are more highly developed.

LETTERS TO THE EDITOR.

The oldest living type of vertebrates.

IT is necessary to add a little to the discussion of Chlamydoselachus in order to give readers of *Science* a just idea of the case as it now stands. On hearing the evidence presented in my paper at the Philadelphia meeting of the American association, Professor Cope gracefully conceded that he had mistaken the affinities of Didymodus, and agreed with me in the conclusions that the two genera belonged to different orders, and that, judging from the teeth alone, the nearest known allies of Chlamydoselachus were Cladodonts of the subcarboniferous and middle Devonian. The shapes of the bodies of the extinct Cladodonts are yet unknown. What has been considered the closest approach to a determination of their skeletal structure is that of Dr. Traquair, based on the resemblance of a single, partly visible, and imperfect tooth of Ctenacanthus costellatus. Professor Gill has accepted the doctor's idea, and classified the sharks, fossil and recent, in accordance (*Science*, iii. 140). The lateral curvature near the apex of the tooth is rather against the determination, and the character of the base is not known. The weight of the evidence does not seem to favor the conclusion that Ctenacanthus is a Cladodont. The tooth resembles that of Rhina as much. Until we are tolerably certain in regard to the extinct (the unknown), it is about as well to assume that it in some degree resembled the recent (the known). In a revision of the arrangement of Gill, the Xenacanthini should be taken from his Lipospondyli to form a new order, the Cladodonts removed and placed with the Selachophichthyoidi, and the definitions revised in several cases to accord with structure. The result would appear thus:—

Xenacanthini, Pleuracanthus, Didymodus, and allies, prototypes of bony fishes.

SELACHIA. GALEI.

1. *Lipospondyli*, including the true Hybodonts, but excluding the Cladodonts.
2. *Selachophichthyoidi*, including Chlamydoselachus and the Cladodonts, but excluding Didymodus; changing the definition from "vertebral condition unknown, and with teeth having fixed bases," to "vertebrae partially or imperfectly developed, notochord persistent, and teeth with broad backward expanded bases."
3. *Opistharthri*, the Notidanidae; changing the expression, "which alone exhibit these peculiarities in the existing fauna," to read, "which share many of their peculiarities with the preceding."
4. *Proarthri*, Heterodontidae.
5. *Mesarthri* (Anarthri Gill), most sharks; changing the statement, "palato-quadrate apparatus not articulated with the skull," to read, "pterygo-quadrate articulated or connected with the skull in the orbit by the trabecular elbow." The name 'Anarthri' is manifestly inappropriate, since few of the genera are without the articulation.
6. *Rhinae*, Rhinidae; changing the definition so that "with the palato-quadrate apparatus not articulated with the skull" shall read, "with the pterygo-quadrate articulated with the skull in the orbit by the trabecular elbow."

S. GARMAN.

Cambridge, Nov. 17.

Water of crystallization.

The first accompanying illustration (fig. 1) is taken from a photograph of plumes produced by the crystallization of water. In the appendix of Tyndall's work on light will be found an illustration (fig. 2) of the

FIG. 1.

same phenomenon which is explained in the following letter from the late Professor Joseph Henry to Professor Tyndall.

"Accompanying this, I send you a photograph at the request of Prof. S. H. Lockett of the Louisiana state university, of which the following is his explanation:—

"'In my drawing-room I kept a wash-basin in which to rinse out the color from my water-color brushes.

olor gradually formed a uniform sediment of efinite tint over the bottom of the basin. On ght of the 26th of December last, which was isually cold one for this climate, the water in sin froze. On the melting of the ice the next e beautiful figure you see on the photographs ft in the sediment. I carefully poured the from the basin, let the sediment dry, and thus ly preserved the figure. It has been accurately raphed by an artist in this city. The negative erved; and, if you would like to have any more they can readily be obtained.

Te are not much accustomed, in this warm y of ours, to the beautiful 'forms of water;' his has me as a emarka- nd wor- f being

e fact e results een pro- by col- ediment ates a l of ex- g the ef- f crystal- n in an esting r."

fessor ll refers s as a rising crystal- n,' which certain-

e years glass- lizing as filled hio-river which ertain carries spension quanti- yellow and al- o settle everal orming a thin yet firm deposit on the bottom dish. During a very cold night the water in h was frozen, and the sediment figured as h represented. The ice was melted, water d, and the sediment dried. I have this re- ble specimen in my possession to-day, just as originally formed.

WM. L. DUDLEY.

[...]ti, O.

FIG. 2.

An open polar sea.

ne of your September numbers (No. 86), there etter from Lieut. Ray on this subject, which, needs some elucidation. Mr. Ray questions stence of an open polar sea, on account of the perature of the water found by the last Ameri- ar expedition. What has the temperature of o do with its greater or less freedom from ice in limates? The temperature of maximum density of sea-water being lower than the freezing-point, the formation of sea-water ice is impeded, as the colder water is not the lighter. If, however, ice forms on sea-water, it is because, 1°, the specific gravity near the freezing-point differs much less (about one-third as much) from degree to degree than near 70°; so colder water has not so strong a tendency to arrange itself according to specific gravity as warm water, and may freeze, especially with cold winds from the land; 2°, at the close of summer the upper layers are generally much less salt than the lower, on account of the fresh water coming from melting ice, and from rivers swelled by the melting snow (this is especially the case in many inland seas of the northern hemisphere, and to a less degree in the southern hemisphere; such an arrangement of the waters allows the upper strata to be colder and yet lighter, and thus is very favorable to the formation of ice); 3°, after ice begins to form, it increases both from below, on account of the cold penetrating the ice, and from above, on account of the freezing of waves, spray, etc., on the surface of the ice.

Now, when the second condition, the most powerful (at least, for the beginning of the formation of sea-ice), is absent, or present only in a small degree, the conditions for the formation of field-ice or sea-ice are lacking, or only present on a small scale. This is more often the case in the high latitudes of the southern hemisphere than in the northern; because in the southern the seas are deeper and more open, and receive little river-water, the temperature of the air and sea is below the freezing-point to about 62° south, and the icebergs reach that latitude without melting.

If the north pole is surrounded by open, deep water, and if the temperature of summer there is lower than at the stations where observations have been made in the northern hemisphere (both suppositions will be granted as possible), there do not exist conditions so favorable for the formation of field-ice as on the north coast of Asia and North America, as there will be no brackish water of a low specific gravity near the surface. Thus there may be relatively open water near the north pole, not warm,

but cold; this only on the supposition of a deep, broad expanse of sea. If not, — if the pole is surrounded by a cluster of islands, like the archipelago of North America, — ice must predominate there, yet probably not so as to entirely exclude patches of open water, since these have been found everywhere in the Arctic.

Mr. Ray does not entertain the idea of a 'polar ice-cap,' — an idea which, unfortunately, lurks in so many heads that should know better (by ice-cap I mean one of great depth and permanence, formed on the open sea, not glacier ice). Mr. Ray's letter led me to look over the controversy on 'geological climates' in *Nature*, 1880–81. The polar ice-cap hypothesis was warmly advocated by Professor Samuel Haughton, who is, I think, considered an authority on this subject, at least in Great Britain. It was not abandoned by him, notwithstanding the strong arguments brought against it, especially by Mr. A. R. Wallace.

A. Woeikof.

St. Petersburg, Oct. 29.

Rhyssa not lignivorous.

In the record of the proceedings of the Brooklyn entomologial society, as reported in *Science* of Nov. 7, Mr. George Gade denies the parasitic nature of Rhyssa lunator, and states that it is a wood-feeder. This conclusion was indorsed by at least two other members of the society at the meeting of Sept. 27, and without any protest. The conclusion is quite erroneous; for not only does the whole organization of this genus of our largest ichneumon-flies point unmistakably to its parasitic nature, but there is plenty of evidence by competent observers on record to corroborate it.

Let me add, that I have had ocular evidence of the fact, as I have in a number of instances taken the Rhyssa larva of various ages and sizes, feeding upon the larva of Tremex columba. The Rhyssa does not sting and oviposit in its victim, however, as is generally supposed, but lays its egg anywhere in the Tremex burrow. The Rhyssa larva seeks its victim, and fastens to it from the outside, and thus develops, as do so many other parasitic larvae. This trait will account for Mr. Gade's observation upon which he based the erroneous conclusion.

C. V. Riley.

Washington, D.C.

Sky-glows.

Several letters in recent numbers of *Nature*, on 'sky-glows,' have reminded me of some observations made last summer during a trip across the Sierra Madre Mountains from Parral to Guadalupe y Calvo, in the state of Chihuahua, Mexico, which may be of interest to the readers of *Science*. The following account of the phenomenon is taken from my note-book under date of June 24, 1884: —

About nine o'clock this morning, as we neared the top of the mountain above San Estavan, at an elevation of 8,900 feet, Col. Matlock, my travelling companion, called attention to the remarkable dimness of the sunlight, suggesting the approach of rain or an eclipse of the sun, as no clouds were to be seen. On looking towards the sun, a peculiar pinkish glow, shading into purple, surrounded it, extending from fifteen to twenty degrees. The remainder of the sky presented a dark-blue, leaden color. The sunlight was so obscured as to give a peculiarly sharp outline to the shadows cast by the trees, and a weird appearance to the landscape. The glow continued throughout the day, which was perfectly clear with the exception of a few small fleecy clouds about noon, that flitted across the sky from the south-west.

We camped at Cuevas Blancas, on a small creek, a little before sunset, at an elevation, as indicated by a small aneroid barometer, of 9,190 feet. A huge rock, unfortunately, shut out the sun as it set; but on one side could be seen the new moon and two planets — Jupiter and Venus — shining with a bright silvery lustre through the pinkish hue of the sun-glow. As the twilight faded away, the color changed to a pale red. The sky at the time was perfectly clear, and the stars came out beautifully. According to my watch, the sun set at quarter-past seven o'clock, and the glow did not entirely disappear until half-past eight.

Wednesday, June 25; the same appearance of a pinkish or salmon-colored glow surrounded the sun as on yesterday, though the sunlight was apparently not so much obscured.

I may add, that a similar glow, though not so marked in appearance, was observed for a week or ten days thereafter. The rainy season, which usually begins in the mountains by the middle of June, had not commenced at the time; and, indeed, there was very little rain up to the last of July, when I left the mountains.

N. T. Lupton.

Vanderbilt university, Nov. 17.

Iroquois grammar.

The assumption of 'Reporter,' that the conclusions of my Montreal paper can affect the value of missionary work, except in illustrating its difficulties, I deny. My critic's own statement, however, that the life and force of the language depend upon the meaning of certain pronouns, and that these must conform strictly to a system of grammar already prescribed, or render the version erroneous, does throw aspersions upon many valuable works.

That the early French missionaries did influence the language of the western Mohawks is evident from their use of words coined by those old fathers; but the statement that their translations conform to those of the east is incorrect.

As the most perfect and complete grammar yet written in the Mohawk has been in my possession for over two years, it has been an easy task for me to find, upon ninety pages scattered throughout Brant's prayer-book, over two hundred instances where the pronouns do not follow the system there prescribed.

In comparing two translations of St. Mark, executed at different localities, we find still greater differences, not only in pronouns, but in the tenses, number, etc. In one of these translations we find that "they that did eat of the loaves were five thousand *warriors*," and, in the thirteenth chapter, that 'those days' which in that chapter refer to the future are translated in the past. These are only a few of the instances which might be given to show the difficulties of those pioneers. When my critic says that the supposition of Indians writing for Indians, and writing incorrectly, is 'inadmissible,' he is the one to cast an undeserved reflection upon the venerable missionary reviser of Brant's prayer-book, who has made numerous changes in these pronouns.

Through the kindness of French missionaries, I have had access to archives rarely or never opened before, have been permitted to bring to my own home their erudite researches, and I have not been so ungracious or ungrateful as to underrate either them, their work, or influence. I refer my friends to the paper read before the American association for the advancement of science at Minneapolis.

Confessedly now and forever a 'beginner,'

Erminnie A. Smith.

THE AGASSIZ ASSOCIATION.

[...] benefit accruing to science from the [...]e work of those who endeavor faithfully [...]ularize its teachings is not always rec[...]d by the investigator. Yet such work, [...] looked down upon by many not taking [...]ouble properly to inform themselves, is [...] of no doubtful recognition. An excel[...]xample, perhaps second to none in this [...]y for its success and beneficial results, [...] founding and conduct of the Agassiz [...]ation, which held its first general as[...] last summer in Philadelphia. The [...] and plan of the association are the work [...]e man, Mr. Harlan H. Ballard. The [...] was first a local institution for youth [...] Lenox (Mass.) academy, of which Mr. [...]d is principal. It proved so successful [...]moting a love for the study of natural [...]mena, that he conceived the idea of mak[...]e experiment more generally useful. An [...]tion to form a general association was [...]red with such unexpected enthusiasm, [...]ver seven hundred local branches have [...]een established, and more than eight [...]nd children and grown people enrolled [...] four years. As the idea was in part [...]sted by the success of a similar society [...]s and girls in Switzerland, the American [...]ation has been very appropriately named [...]Louis Agassiz, whose sympathy and ear[...]vork in behalf of popular education has [...] his name historical in both Switzerland [...]merica.

[...] association was originally planned for [...]enefit of the young. It was speedily [...]ained, however, that its methods of en[...]ging study by out-door collecting, by [...]quent talks, and by arranging exchanges [...]others, were much more effective stimu[...] than had been imagined; and other [...]ers besides the principal of Lenox acad[...]ound them useful in their schools.

[...] the regulations of the association, chap[...]ay be established by a few persons, four [...] the minimum limit; and age having been [...] left out of account, many families have formed separate chapters. In some cases single persons of mature age, living in remote places, have found its advantages such that they have been admitted as correspondents. The voluntary labor of students in various departments has been secured, so that chapters and correspondents can obtain the information they need at first hand; and the extensive correspondence to effect this result has been conducted without charge by Mr. Ballard. By the co-operation of the editors of *St. Nicholas*, a monthly report is printed in that journal, without expense to the association. The magazine has thus become instrumental in helping to support the association, and deserves all the honor and credit won by such good offices.

Classes for the systematic study of elementary botany, entomology, anatomy, and physiology, have been formed under the leadership of competent teachers, and conducted by correspondence. Self-help and independent exertion are in this way made necessary for every isolated chapter, and this is systematically encouraged by all the influence of the leader of the association. Much good must have been already done in this way in direct opposition to the whole tendency of the ordinary training of the schools, and we are much mistaken if both pupils and teachers have not in many cases been greatly benefited by their experience in this really higher class of educational work.

We are told by the president, in his 'Handbook,' that the association is designed to be an extended free school of the natural sciences, open to persons of all ages and conditions. We cannot avoid a smile, however, when he adds that the association is intended to resemble the 'great school at Chautauqua;' for that school, with its large annual attendance and camp-meeting organization, is not one-tenth part so valuable to the intellectual interests of this country as either the Agassiz association or the somewhat similar 'Association for the promotion of home studies,' founded by Miss Ticknor of Boston. The conductors of these enterprises have done something permanent and effectual towards spreading a taste for

self-culture in an almost new sense, so far as the majority of people are concerned. They have shown that there is a practicable method by which the average intelligence and self-reliant character of the people outside of the schoolroom, as well as in it, can be effectively increased, and have taught thousands how to work with whatever means were at hand, not only for their own intellectual improvement, but for that of their children and neighbors. This must eventually affect the curriculum of the public schools through the creation of a demand for better and more natural methods of instruction. Indeed, if Mr. Ballard were to do nothing for the remainder of his life but carry on and perfect the system he has originated, and so extend the influence of his society, he could do nothing more desirable for the interests of science in this country, or more likely to secure future happiness and personal satisfaction for himself.

There is, however, in the path of this new organization, a certain danger arising from its necessarily intimate association with a publishing enterprise like that of *St. Nicholas*. Publishers and editors must do what will be profitable, and cannot afford too much philanthropy in their business. This spirit appears in the title, 'St. Nicholas Agassiz association,' as it stands upon the titlepage of the 'Handbook.' The incongruity of names offends good taste, and does not accord with the purely unselfish nature of the whole enterprise. There is also a real cause for apprehension in one clause of the constitution, which places the appointment of his successor in the hands of the president and the editors of the *St. Nicholas*. Most persons will translate it as having but one object, — that of securing to the publishers and editors, in the future, whatever advantages may flow from the prosperity of the society. However pardonable and strictly honorable this may be from a business point of view, it is not consistent with the scheme of the association, and will finally excite comment and dissatisfaction. It might have been necessary to confine the power of appointment and election in a society of children; but this association is no longer composed wholly of young persons, and has admitted large numbers of adults. The proprietors of *St. Nicholas* have a chance to lay the whole society under obligations of a kind which such bodies of people, in our experience, have never failed to recognize with gratitude and appropriate acknowledgments. We should earnestly advise them to take advantage of their opportunity.

THE 'POROROCA,' OR BORE, OF THE AMAZON.

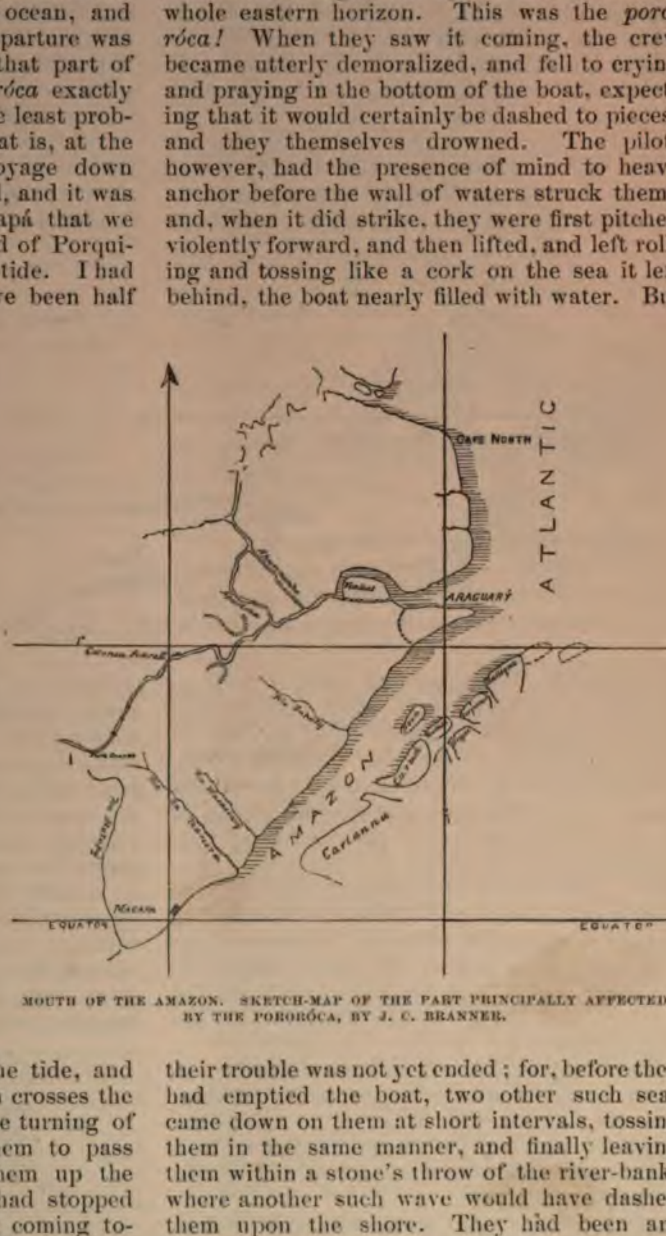
WHILE travelling upon the Amazon in 1881, I was fortunate in having an opportunity to observe some of the effects of a remarkable phenomenon which occurs at the northern *embouchure* of that river, in connection with the spring-tides. It is known to the Indians and Brazilians as the *pororóca*,[1] and is, I believe, generally supposed to be identical with the 'bore' of the Hugli branch of the Ganges, of the Brahmapootra, and of the Indus. I regret very much, that like Condamine,[2] who passed through this part of the country about 1740, I could not observe this phenomenon in actual operation; but the gentleman whose guest I was at the time, and upon whose boat I was a passenger, was fairly horrified at my suggesting such a thing, while his boatmen united in a fervent 'God forbid that we should ever see the *pororóca!*' and ever afterwards doubted my sanity. I venture, however, to give some of the results of my own observations, in order that those who in the future visit this region, concerning which so little is known, may be able to see, and establish as far as possible, the rate of destruction and building-up here being carried on.

I was upon a trip from Macapa, — a small town on the northern bank of the Amazon, and about a hundred miles from its mouth, — down the river to the ocean, and thence up the Rio Araguarý as far as the last might be found navigable. The one inhabited place on the Araguarý is a military colony, called the Colonia Militar Pedro Segundo. At Macapá I became acquainted with the then director, Lieut. Pedro Alexandrino Tavares, and was invited by him to visit the Araguarý.

[1] This word, which is of Tupý or native Brazilian origin, is the one invariably used by the Brazilians. Father João Tavares says it is probably a frequentative form derived from the Tupý word *opoe*, which means 'to break with a noise.'

[2] Condamine was sent by the Royal academy of sciences, of France, to make astronomical observations in South America in 1735. His description of the *pororóca* is the one from which all references to it have been taken until now.

rip from Macapá was by a small sail-
wn the Amazon to the ocean, and
p the Araguary. Our departure was
ged that we could reach that part of
on disturbed by the pororóca exactly
me when there would be the least prob-
of its being met with; that is, at the
the neap-tides. The voyage down
was in the face of the wind, and it was
days after leaving Macapá that we
an *igarapé* on the Island of Porqui-
wait for the turning of the tide. I had
seen islands said to have been half
away, and others built
he *pororóca;* and I had
on the shores the evi-
of its destructive power
ing away forests, and
away banks: but it was
island that I was first
see some of its effects
hand, and at my leisure.
aving seen so much, I
y the more anxious to
pororóca itself; but my
ons in regard to it were
d by an ominous silence
part of the director, and
uests by additional ex-
s of horror.
shortly afterwards met
versed with a man who
n the *pororóca*, I shall
e his description of it,
speak of its effects as
d by myself. This man
soldier in the Brazilian
nd, on the occasion re-
o, was going with a few
ldiers from the colony
pá in a small open boat.
at the mouth of the
ý, they went down with the tide, and
d just inside the bar which crosses the
of this stream, to await the turning of
, which would enable them to pass
llows, and then carry them up the
. Shortly after the tide had stopped
out, they saw something coming to-
em from the ocean in a long white line,
ew bigger and whiter as it approached.
ere was a sound like the rumbling of
hunder, which grew louder and louder
hite line came nearer, until it seemed
whole ocean had risen up, and was
charging and thundering down on
oiling over the edge of this pile of
ke an endless cataract, from four to
seven metres high, that spread out across the whole eastern horizon. This was the *pororóca!* When they saw it coming, the crew became utterly demoralized, and fell to crying and praying in the bottom of the boat, expecting that it would certainly be dashed to pieces, and they themselves drowned. The pilot, however, had the presence of mind to heave anchor before the wall of waters struck them; and, when it did strike, they were first pitched violently forward, and then lifted, and left rolling and tossing like a cork on the sea it left behind, the boat nearly filled with water. But



MOUTH OF THE AMAZON. SKETCH-MAP OF THE PART PRINCIPALLY AFFECTED BY THE POROROCA, BY J. C. BRANNER.

their trouble was not yet ended; for, before they had emptied the boat, two other such seas came down on them at short intervals, tossing them in the same manner, and finally leaving them within a stone's throw of the river-bank, where another such wave would have dashed them upon the shore. They had been anchored near the middle of the stream before the waves struck them, and the stream at this place is several miles wide.

But no description of this disturbance of the water can impress one so vividly as the signs of devastation seen upon the land. The silent story of the uprooted trees that lie matted and tangled and twisted together upon the shore, sometimes half buried in the sand, as

if they had been nothing more than so many strings or bits of paper, is deeply impressive. Forests so dense that I do not know how to convey an adequate idea of their density and gloom, are uprooted, torn, and swept away like chaff; and, after the full force of the waves is broken, they sweep on inland, leaving the *débris* with which they are loaded, heaped and strewn through the forests. The most powerful roots of the largest trees cannot withstand

SKETCH ON THE ILHA DOS PORQUINHOS, SHOWING THE UPROOTED TREES.

the *pororóca*, for the ground itself is torn up to great depths in many places, and carried away by the flood to make bars, add to old islands, or build up new ones. Before seeing these evidences of its devastation, I had heard what I considered very extravagant stories of the destructive power of the *pororóca;* but, after seeing them, doubt was no longer possible. The lower or northern ends of the islands of Bailique and Porquinhos seemed to feel the force of the waves at the time of my visit more than any of the other islands on the south-east side of the river; while on the northern side the forest was wrecked, and the banks washed out far above Ilha Nova.

The explanation of this phenomenon, as given by Condamine, appears to be the correct one; that is, that it is due to the incoming tides meeting resistance, in the form of immense sand-bars in some places, and narrow channels in others.

Most persons who mention the *pororóca*, say that it breaks as far up the Amazon as Macapá; and, indeed, the people of Macapá themselves often refer to the rapid cutting-away of the river-banks near their city as the work of the *pororóca*. It is true that these banks are being rapidly cut down; and it is even a common thing to see, in this part of the country, the stilted houses — the floors being nearly two metres from the ground — that were originally built one, two, or three hundred feet from the water, gradually encroached upon until they fall into the stream. A portion of the old fort at Macapá was, at the time of my visit, about to fall, on account of the land upon which it was built being washed away; but all this is the work of a rapid current, for the surf of the *pororóca* does not reach Macapá, though it may reach a little farther west than I have represented on the map. Moreover, there is a marked difference in character between the washing done by the *pororóca* and that done by the ordinary river or tide current. The latter works from below, and, by undermining and softening the bank, causes what is known through the Amazon valley as *terras cahidas*, or fallen banks. The land falls into the stream in sections of various widths, and not infrequently these form temporary terraces miles in length. These *terras cahidas* are most common and most extensive on the upper Amazon during high water, but they may be seen on a small scale at various places through the valley. The accompanying diagram and sketch were made near Mazagão, on the lower Amazon. From this it is clear that the work of destruction goes on entirely below the surface. With the *pororóca*, on the contrary, the water is dashed fairly against the banks, and the earth is washed away from above as well as from below, and the shore is left perfectly clean. The depth to

SECTION OF A FALLING BANK ON THE AMAZON.

which the banks are cut shows that this disturbance is also a profound one; so much so, indeed, that on the north-west side of Porquinhos the deepest place in the channel of the river was, in 1881, close to this island, where the action of the *pororóca* was most violent.

hrough this region the *pororóca* is instrumental in the rapid and marked that are constantly going on. The f the Amazon is notoriously muddy; would naturally be expected, these nces in comparatively shallow places much more so, and fill it with all the t it can possibly carry. Even when I the Araguarý, a time when there was t possible tidal disturbance, the water mouth of this stream was so muddy, hick sediment would settle in the bot- a vessel of it left standing a single though the water of the Araguarý as far down as the Veados, is of a clear,

M. HIGH, WASHED BY THE POROROCA, FORMERLY COVERED WITH FOREST.

lor. But the work of tearing down and building up are equally rapid, and the le world takes quick possession of what offers it; and, while some islands are orn away, others are being built up, old s being filled, islands joined to the main- d promontories built out. To the north- Faustinho is an island known as the va ('new island'), about ten miles long t three wide, when I saw it, and which, ssured by several trustworthy persons, exist six years before. In 1881 it vered by a dense forest. The young were sprouting at the water's edge, hind a little taller, and so on; so that etation sloped upward and back to a om twenty to thirty metres high in the of the island.[1] Again: on the southern the mouth of the Araguarý was a point nearly or quite six miles in length, and with vegetation, from young shoots to six metres high. I was told, that, one fore, this was nothing more than a sand- hout a sign of vegetation on it. The end of the Island of Porquinhos was own as Ilha Franco; but the channel arated it from the Porquinhos has been gradually, and the two islands are now ough the upper end of it is still known nco. The point in the mouth of the ý known as the Ilha dos Veados ('deer was, at the time of my visit, fast being o the mainland. A couple of years before, boats navigating the Araguarý passed through the channel on the south side of the island. In 1881 it was no longer navigable, and the Veados was rapidly being made part of the right bank of the river.

Owing to this shifting of material, the pilots never know where to find the entrance to the Araguarý River. One week the channel may be two fathoms deep on the north side, and the next it may be in the middle; or it may have disappeared altogether, leaving the river-bed perfectly flat, with only one fathom of water across the whole mouth. The bar was in this last-mentioned condition when I passed over it in 1881. At this time another bar extended eastward from the eastern end of Bailique; while a little farther out was another just south of the same line, as I have indicated on the map. The shifting nature of the sand-bars about the mouth of the Araguarý renders it unsafe for vessels drawing more than one fathom to enter this river, except at high tides. But, as high tides and the *pororóca* come at the same time, only light-draught steamers can enter by waiting well outside the bar until the force of the *pororóca* is spent.

With the few canoes or small sailing-vessels that enter this stream (probably less than half a dozen a year), it is the custom to come down past Bailique with the outgoing tide, and to anchor north of the bar that projects from the southern side of the Araguarý, and there to await the turn of the tide to ascend the latter river. Care is always taken to pass this point when the tides are least perceptible.

Although the *pororóca* breaks as far up the Araguarý as midway between the Veados and the entrance to the Apureminho, its violence seems to be checked by the narrowing of the stream below the Veados, by the turns in the river, and by the vegetation along the banks.

This vegetation is of the kind against which it seems to be least effective, namely, bamboos. They grow next the stream from near the mouth to the foot of the falls above the colony, and form a fringe to the heavy, majestic forest behind them, than which nothing could be more strikingly beautiful. The clusters next the stream droop over till their graceful plumes touch the surface of the water; and, as the plants grow older, they droop lower, until the stream is filled with a yielding mesh of canes. I measured a number of these bamboos; and the longer ones, taken at random, were from twenty to twenty-five metres in length, and from seven to ten centimetres in diameter. A more effectual protection against the *pororóca* could hardly be devised.

lants growing upon this newly formed land are all of They are called *Ciriúba*, or *Xiriúba*, by the inhabit- elong to the family Verbenaceae, genus Avicennia.

On Bailique and Brigue I found the forests very different from any I had hitherto seen in the tropics. These islands, like all the others in this part of the country, are flooded at high tide during part of the year; and, as a consequence, they are very like great banks of mud covered with the rankest kind of vegetation. This vegetation varies with the locality. All around the borders, Brigue is fringed with tall assai palms, bamboos, and various kinds of tall trees, all of which are hung with a dense drapery of sipós (lianes) and vines, which form an almost impenetrable covering. Inside of this are several palms, the most common being the ubussú (Manicaria saccifera). The next in order are the murumurú (Astrocaryum murumurú), urucurý (Attelea excelsa, the nut of which is used for smoking rubber), and ubim (Geonoma). But, unlike most tropical forests, this one has very little or no undergrowth, except upon the borders. Most of the ground was under from one to six inches of water, while the exposed places were covered with fine sediment deposited by the standing muddy waters of the Amazon. I walked several miles through this forest without finding any palms except the ones mentioned. The little ground above water was covered with the tracks of deer, pácas, cutías, and of many kinds of birds, mostly waders; but the deathlike stillness was unbroken, save for the little crabs that climbed vacantly about the fallen palm-leaves, or fished idly in the mud for a living.

This vast expanse of muddy water, bearing out into the ocean immense quantities of sediment; the *pororóca*, breaking so violently on the shores, and carrying away the coarser material to the open sea, and burying uprooted forests beneath newly formed land; the rank vegetation of islands and *varzea* rapidly growing and as rapidly decaying in this most humid of climates; the whole country, submerged for a considerable part of the year by the floods of the Amazon, — impress one with the probability of such phenomena having been in past ages, and still being, geological agents worthy of study and consideration. Across the mouth of the Amazon, a distance of two hundred miles, and for four hundred miles out at sea, and swept northward by ocean-currents, beds of sandstone and shale are being rapidly deposited from material, some of which is transported all the way from the Andes, while in many places dense tropical forests are being slowly buried beneath the fine sediment thrown down by the muddy waters of the great river.

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HISTORY OF ALMANACS.

THE derivation of our English word 'almanac' seems doubtful. The word possibly came from *almonaght*, Saxon words meaning 'the observation of all the moons.' In Roman times the priests announced once a month to the people what days should be observed as holidays, basing their calculation upon the movements of the moon. In this way almanacs arose to give information of church feasts. Then superstition entered, and caused an interest to be taken in the movements of the planets. As the earth was held to be the centre around which moved the moon, the planets, and the stars, and as the moon was seen to have an influence upon the tides, the inference was drawn that human affairs could but be affected by these outside bodies which were supposed to have been created for the benefit of the world alone.

The earliest calendars known were cut upon rods of wood or metal, some of the Roman calendars on blocks of stone. The earliest written almanacs were of two classes, — the first containing astronomical computations; and the other, lists of saints' days, and other matters pertaining to the church. Both are sometimes found united; although the latter claimed greater antiquity, being prefixed to most ancient Latin manuscripts of the Scriptures. We reproduce from the 'Glossaire archéologique' of Victor Gay a church calendar of the fourteenth century, in which the leaves are made of box-wood, the pages reproduced giving the calendars of January and December. The first printed calendar was issued in 1472, by Johannes de Monte-Regio; and before the end of that century they became common on the continent. In England they were not in general use until the middle of the sixteenth century; and the making of calendars interested the best mathematicians of the time, which was not the case a little later.

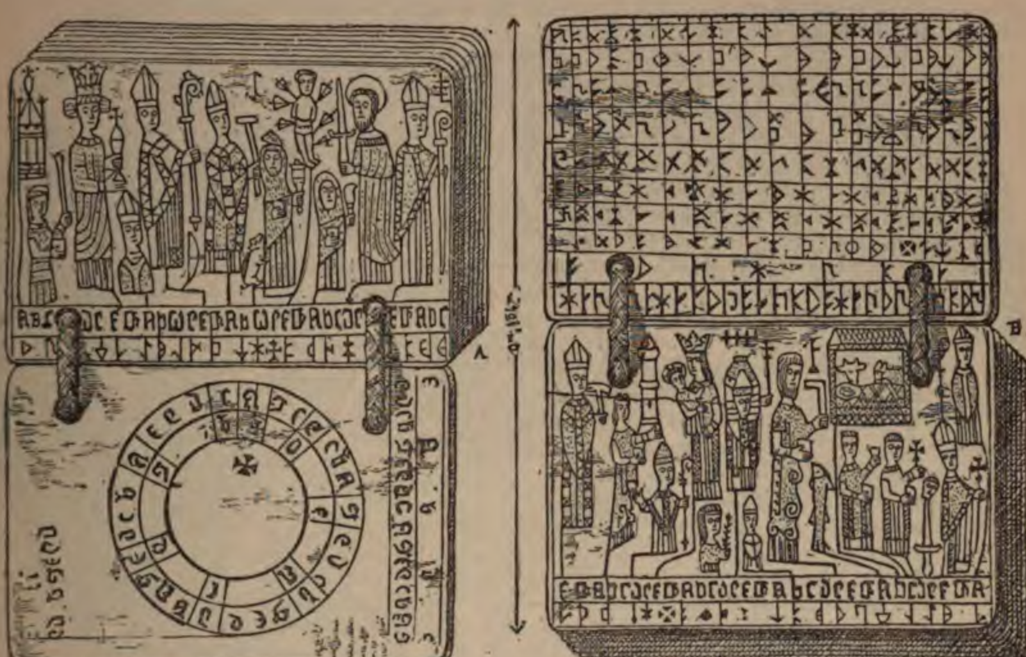
From the earliest times, calendars were filled with advice to physicians and the farmer: the farmer is told when to plant, and the sick man when to take physic. We quote here from an almanac published in 1628, in London, by Daniel Brown, — "Willer to the Mathematickes, and teacher of Arithmeticke, and Geometry," — the titlepage of which bears the inscription, 'Astra regunt homines et regit astra deus.' the paragraphs on

"*Judiciall Astronomy.*

"It hath beene an order and a custome (amongst the most excellentest and wisest Physitions, to choose the Moone for the principall. Significatrix of the sicke Person, and according unto her motion, situation, and configuration (with other Planets) haue giuen judgement on the increasing, mittigation and alteration of the disease; which of the Physition is called Crisis, that is a swift and vehement motion of a disease, either to life or death, and it hapneth about the supreame intention of a disease. And Galen (in commento de diebus Criticis) sayth. A Physition must take heed and advise himselfe of a certaine thing that faileth not neither deceiveth,

which the Astronomers of Egypt taught) that is to say when the body of the Moone is joyned with fortunate Plannets and Starres, dreadfull and fearefull sicknesse commeth to good end. And therefore the expert in that excellent science of Physicke, doth obserue and marke how the Moone passeth through the Zodiacke; and with what Planets she is joyned; thereof they do vnderstand much of the alteration of the sicknesses, for the Moone with the good Planets, as Iupiter and Venus, or aspected well of them tendeth to good. Contrarywise with the euill Planets as Saturne and Mars, or euill aspected of them, doth pronounce and cause euill essence of the sickenesse, in so muth that such dayes in euery moneth is to be accounted more dangerous then the rest to fall sick causeth the mutability and alteration of mens bodies, to bee good or euil, according to the nature of that Planet with whom she is adjoyned, which agreeth to the saying of Ptololeus in the 16. Aphorisme of his Centi loquio. Behold the motion of the Moone as she passeth through the Criticall, Judicial and mortall dayes, for if she be in them fortunate, it will fall out well: if Unfortunate, the contrary. And by the censure of the great. Astrologicall and Theologicall Doctor Fruuncis Iunctinus, that by the motion of the Moone and Planets are knowne the Criticall and dangerous dayes, when the sicknesse will bee more remisse and placable. And when it is convenient to vse outward, or inward medicines.

"Concerning cautions in ministration in Physicke ,



A CHURCH CALENDAR OF THE FOURTEENTH CENTURY.

in. Which dayes I have noted in my Almanacke, with their Characters, under the Aspects of Luna to Saturne and Mars. Thus a ☌ Conjunction, this a □ Quartile, this a ☍ Opposition: For example, The 5. day of Aprill, the ☌ of Saturne and Luna the Moone, being in Virgo of ♄ afflicted, the griefe shall proceede of viscuous and tough fleame. The thirteenth of Aprill the ☍ of Mars and Luna, the Moone being in ♐ of ♂. afflicted, the griefe is of blood and red choller. For Astrologers say, that among all the other Planets the Moone (in ruling) hath most power and mastry of mens bodies. Ptolomeus saith, under the moone is contained sicknesse, therefore about the alteration of mans body, the Moone worketh principaly; and because her orbe is neerest to the earth, sendeth vs the vertue and impression of the other Planets; and as purgations, laxatiue, or phlebotomie, seeing the fore sight, and preuention of such especially appertaineth to the learned in Physicke, wherein they can helpe themselues, and others, God giuing a blessing to their practise, for of the most high commeth healing. I commit them to the consideration of the learned, in that excellent Science of Physicke and Chyrurgery."

Prognostications of the weather were also called for by the readers of almanacs; and the following rules, quoted from a manuscript in Lambeth palace, as given by Mr. Halliwell-Phillips, may be of service to those whose faith in the moon is still strong, and who may wish "to knowe what wether shall be all the yere after the chaunge of every moone by prime dayes."

[illegible] wethe.
[illegible] wether.
[illegible] cold and wynde.
[illegible] mervelous.
[illegible] Sonne and clere.
[illegible] fayre and fowle.
[illegible] rayne."

[illegible] has largely entered [illegible] The first [illegible] men might save [illegible] days; and the [illegible] and take their [illegible] Of course, all this wis- [illegible] was often scoffed [illegible] probably be found, [illegible] constant users of the almanac are those who thumb them over with the expectation of finding similar guidance. When criticised, they reply that it is just as well to be on the safe side.

One of the earliest American almanacs, which also served as an altar upon which to offer human sacrifices, and which has given rise to such lively discussion among the antiquarians, was the Mexican calendar-stone.

THE MEXICAN CALENDAR-STONE.

The Mexican year was a solar year of three hundred and sixty-five days. Their old calendar consisted of three hundred and sixty days, to which they finally added five. Each day had a name except the added five. The year was divided into two parts, — one of two hundred and sixty days, called *meztli pohualli* or 'moon-reckoning;' and a smaller portion of a hun

hundred and five days, called *tonal pohualli*. was divided into eighteen months of twenty h: the five extra days were looked upon as and unlucky days. The week was only five . Further, they recognized a cycle of fifty- rs, each had a during night of f which l might an end. e Mexi- endar- e sun- present- middle, ounding symbols sixteen the day. r larger indicate nid-day, nd mid- The sub- of eight marked smaller while n hours ated by towers corre- ng dis- In the elt sur- ng the ield are e sym- r the Mexican begin- the left ntre at nd run- nd con- e hands h. The med *Ci-* the as- who the five e year; ond is *checatl*); and l, *calli*), showing a Mexican house with flat roof. ing this is a narrow zone of squares, each g five points divided into four lots of ten ch, which gives two hundred dots. There g sixty dots to make up the larger subdivision of the year; and it will be noticed that the space for these is exactly occupied by the pointers, the lines across the pointers indicating that the zones are supposed to be continued under them. The other division of the year contains a hundred and five days as represented by the zone of glyphs just outside the zone of dots, and it will be found to contain a hundred. The missing five are seen directly under the sun's face. There only remains the representation of the fifty-two years cycle, and this is found in the outer belt. Every fifty-two years the sacred fire was rekindled, the ceremony beginning with human sacrifices, and ending by the rekindling of the fire by rubbing a stick in a hollow piece of wood. This rekindling is symbolized in each of the figures of the outer belt. The vertical column represents the stick, and the flames are seen rising at either side. The belt just within this outer one symbolizes the destruction of the world by rain, being a rough representation of clouds, with four streams of rain descending from each. The Mexicans had a tradition of four destructions of the earth, — one by war, symbolized by the tiger's head above the sun at the right; another by wind; another by rain; and the fourth by great flood. The four squares around the sun-head are supposed to symbolize these epochs. The antiquarian would

BICKERSTAFF'S
BOSTON
ALMANACK,
For the Year of our REDEMPTION,
1785.
Being the First after Leap-Year and Ninth of American INDEPENDENCY. Fitted for the Meridian of BOSTON, Lat. 42° 25' N.

BOSTON: Printed and sold by E. Russell, next Door to Liberty-pole, by Wholesale or Retail, cheap. George's Almanack is in the press.

THIRD EDITION.

[illegible]

... Here [illegible] per hour. The [illegible] within the arctic circle. Most of the tributaries are from the north, and they are generally shallow but rapid flowing, [illegible] the [illegible] in some instances the [illegible] while in one case it [illegible] was found [illegible]. [illegible] the Pah [illegible] by them in [illegible] passage from its [illegible] one of the northern [illegible] and they are thus [illegible] with the [illegible] passage can be [illegible] discovered by [illegible] which empties [illegible].

[illegible] are [illegible] but they are [illegible] each of [illegible] some [illegible] while [illegible]. The higher [illegible] feet. From the [illegible] the whole [illegible] a confused mass of [illegible] the [illegible] Arctic Ocean.

[illegible] was [illegible] a warm [illegible] the thermometer [illegible] while the nights were [illegible]. The [illegible] is heavily timbered with [illegible] and willow; [illegible] being seen in [illegible] together [illegible] and a large [illegible] collected for [illegible].

While Lieut. Stoney was [illegible], Ensign Purcell [illegible] of the schooner, [illegible] and the Selawik. He found that the Selawik River represented [illegible] but there is a channel, [illegible] connecting Selawik Lake with a [illegible] eastward. He also found [illegible] the Hotham-inlet bar.

The [illegible] schooner, and Lieut. Stoney was provided with two officers and a [illegible] men. There were no naturalists with the expedition.

While returning from the expedition, Lieut. Stoney [illegible] severe gales. During one of the [illegible] oil for stilling the waves, [illegible]. The oil was rigged upon a spar [illegible] and the vessel was [illegible] off the weather-bow. The [illegible] was so constructed that the oil was [illegible] by each advancing wave. All the waves were affected by the oil, but the great foaming combers most markedly.

THE BIRD-COLLECTION OF THE U.S. NATIONAL MUSEUM.

In the register of specimens belonging to the bird department of the National museum, which records

ete known data of every specimen received, er 100,000 has been passed.

llection is by far the most complete of any, presentation of North-American birds and he West Indies; while, of South and Cen-ican birds, only two collections — those of Sclater and Messrs. Salvin and Godman in — excel it. These are superior in the num-cies represented, but are decidedly inferior the number of specimens; the aim of the eing to acquire series which will illustrate tant subjects of geographical distribution ion, thus furnishing material for those in-g the higher branches of the science. In 1, Japanese, and European birds the col-also tolerably complete; but of African, ndo-Malayan, and Polynesian species, there any important deficiencies. These, how-being rapidly filled by exchange and other-hat a fair collection of old-world birds is stion of time. It may be explained, with exotic birds, that the chief aim of the mu-acquire representatives of, first, the higher represented in the American fauna; sec-ra and species allied to American forms; , typical species of the more distinct gen-1 each family.

ensive and unique collection of birds now by the museum has grown from the private of Professor Baird, consisting of three six hundred and ninety-six specimens, llected, prepared, and labelled by Professor his brother, William M. Baird, from 1830 ut embracing also many, if not most, of of Audubon's works, presented to Professor Mr. Audubon. The catalogue of this col-Professor Baird's handwriting, forms vol-he museum registers of the bird-collection, comprises eighteen volumes, containing a of every specimen. In the case of speci-ch are the parents of eggs collected, the register number of the latter is given in a column; while in the egg register the num-parent, if in the collection, is given in a ling place.

at bulk of this collection is in the form of d skins, arranged in insect-tight drawers, nts of which are, as far as practicable, a the outside; the arrangement being so that any specimen in the entire collection eadily found within five minutes of the called for. The number of specimens unted or exhibition collection is, for several ecessarily small. In the first place, the able for their exhibition are in every way , being old and badly constructed, admit-both dust and insects, thus rendering risk to put valuable specimens inside of ere suitable cases provided, the number ens which the public could view might ncreased from six thousand (the number, tely, now on exhibition) to fifteen thousand without materially weakening the 'study series,' or putting in the cases specimens of no interest to the general public.

Labels designed with special reference to the needs of the non-scientific public are being prepared for the mounted specimens, and will be attached to them as soon as possible.

Ornithologists will rejoice that Professor Baird has lived to see the gradual development of a grand national collection from the humble nucleus upon which it was built. The pleasant associations which his memory, no doubt, recalls, must be no less a source of happiness to him than the opportunity of witnessing the important and far-reaching results of his boyhood studies. All wish for him the satisfaction of realizing the consummation of the plans conceived during his maturer years, not the least of which, perhaps, may be the perfection of a national establishment for the study of natural history, which shall be alike attractive and instructive to the general public, and accessible to the special investigator, under the auspices of a government which should take pride in fostering and maintaining a natural-history museum such as no other country can boast.

As being more than any living person entitled to the privilege, specimens numbered 100,000 closing the first century of thousand, and 100,001 commencing the second, are entered as donations from Professor Baird. They were collected in 1850, and presented to Professor Baird by Mr. George N. Lawrence of New-York City, to whom belongs the honor of being the oldest active American ornithologist, and an associate of Professor Baird in his classical work on North-American birds published in 1858.

ROBERT RIDGWAY.

OVER-PRESSURE IN SCHOOLS.

THE subject of over-pressure in schools is being seriously agitated in many European states. In England the discussion just now is related to the report of Dr. Crichton-Browne upon over-pressure in the Board schools of London. This gentleman was invited by Mr. Mundella to examine the schools from his stand-point as a medical expert, and report his observations and conclusions as to the effect of the system upon the health of the scholars. As eventually issued by the education department, the report is accompanied by a memorandum from the pen of Mr. F. G. Fitch (one of her Majesty's inspectors), who severely criticises Dr. Browne's method of investigation, his arguments and conclusions. The press has entered upon the controversy with considerable ardor, so that over-pressure and Dr. Crichton-Browne are topics of the day.

The characteristic features of the English Board school system, the rigid arrangement of subjects and standards, the government inspection, the complicated scheme of examinations, and the payment by results, are unlike any thing that is known, or that would be tolerated, in America; nevertheless, the two systems have certain tendencies in common. In both, the animating impulse of the schools is derived

largely from the standard by which the results are periodically estimated, which standard is an *a priori* conception of the powers and capacities of the young. This is not the only, and possibly not the best, means of estimating a process of growth; but it is the only one encouraged under the English code, and the only one that is likely to be employed among us, so long as the majority of parents demand, not that their children shall grow, but that they shall overtake some one else's children in the race.

Wherever an artificial stimulus is employed, there will be over-pressure to a greater or less extent; and it is this fact which Dr. Crichton-Browne has brought out most effectively. The backward children, whom he judges to be incapable of accomplishing an ordinary year's work without undue strain, include the dull, the delicate, and the half-starved. In this country the last-named class are virtually outside the operation of the influences that produce over-pressure; but of dull and delicate children we have a full quota, and it is well for parents to consider the risk that attends the endeavor to force such to keep pace with those whom 'God has made full-limbed and tall.'

It is difficult to establish a relation between educational processes and vital statistics; but there is reason to infer the connection, whenever, as Dr. Browne expresses it, "diseases due to nervous conditions, identical with those that educational over-pressure sets up," are on the increase. That this is the case in England is shown, Dr. Browne believes, by the statistics of mortality from hydrocephalus, cephalitis, diabetes, and kindred diseases. Nor does he stop here. "We have signs," he says, "which can scarcely be misinterpreted, of the tendency of education, when not safe-guarded by physiological discretion, to overthrow mental equilibrium. Suicide, which is the crowning symptom of one type of insanity, has been spreading portentously during the last hundred years. A startling revival of it has occurred all over Europe; and the rate of suicide calculated on the entire population seems to have quintupled in the last century. It is," he says further, "an indisputable fact, that the revival of suicide in almost every country of Europe has coincided in time with the modern extension of education, and that suicides are now most numerous in the very regions where education is most widely diffused. The number of children under sixteen years of age in the list of suicides, although still comparatively small, is swelling annually; and the age at which the maximum number of suicides occurs in England has receded considerably in the last half-century, showing that the disposition to self-destruction arises now earlier in life than it was wont to do in former times."

Dr. Browne's personal investigations in the schools were directed to ascertaining the extent of headache, sleeplessness, neuralgia, etc., among school-children. It is sufficient to note the line of inquiry, without going into the tabulated results, more especially as the author admits that they are merely tentative.

Attention has already been drawn in the pages of *Science* to the action taken by several German s with reference to overwork in the Gymnasien Realschulen. More recently, in accordance witl commands of the Prussian minister of instruc a report on the subject has been prepared b 'Royal scientific commission on medical aff including Professors Virchow and Hofmann, ten other members of almost equal note. The missioners go into a detailed discussion of th servations submitted to them by the governm touching suicide and insanity among scholars, l ache, bleeding at the nose, congestion of the t and general physical and mental weakness. In of all the information attainable, they state ' the requisite data are wanting for a scientific mate of the extent of over-pressure among the p in higher schools;" and they express the opi that, for the collection of such data, "the co-ope of competent medical men is indispensable." do not, however, overlook the fact that there are essential points involved in the inquiry, of whic teachers alone are the proper judges. The com sioners especially insist that teachers must not ure the strength of their scholars all by the standard.

The agitation of the subject of over-pressu not confined to England and Germany. Inform reaches us that the minister of public instructi France has reduced the hours of study in seco schools. In Switzerland, where the evidenc over-pressure are startling, the cantonal governm are considering the best means of counteracti evil. At the recent international medical con Copenhagen, Dr. Kjellberg of Upsala made found impression by his statements concernin effect of study upon the health of children. symptoms of excessive brain-work on the p the young, which he had noticed, were hea sleeplessness, intellectual torpor, muscular wea and spasm, culminating in hallucination, and of sudden loss of consciousness.

Little or no effort has been made in the U States to collect data bearing upon the subje there is reason for supposing that over-pressure so common here as in countries where educa more highly developed. It would, however, b for us to take warning in time, and seek to fo such effects as those described by the various e who have investigated the matter in Europe should be particularly cautious about adve European systems of education before we ha certained their ultimate effects.

NEW-ENGLAND ORCHIDS.

The orchids of New England: a popular mono By HENRY BALDWIN. New York, *Wiley*, 158 p., illustr. 8°.

LOVERS of flowers have always wonde and admired the beauty and oddity of or which are sure to form the most inter

a collection of exotics; but since the [...] for their many strange and complicated [...] was set forth by Mr. Darwin, in his work [...]r fertilization, the name 'orchid' at once [...]ts a plant worthy of more careful study. [...] we do not have Angraecum, Pterostylis, [...]setum among our wild plants, to indicate [...]treme adaptation to insect-pollination of the family is capable, our flora contains species quite as interesting to the student [...]se to be seen in most collections; and [...]aldwin has done very good service in [...]ing the scattered notes on their pecul[...]. Of the fifty-nine species or well[...]d varieties of our eastern flora, no less [...]orty-seven are found in New England; [...]t the book is of more than local interest. [...]few exceptions, the sixty illustrations, [...]rger ones mostly from nature, are very some are excellent, and show not only [...]nist's knowledge, but an artist's appre[...] of light and shade and of the value [...]vell-selected background. The writer's [...]s pleasing; and, if the professional bot[...]night feel disposed at times to criticise [...]acrificing something of precision for the [...]f avoiding technicality, it contrasts very [...]bly with the many popular books whose [...]merit is their style, since every page personal study. It is not surprising popular book on a group which has long [...]an object of special observation should [...]n little that is new; yet this is far from entirely devoid of new matter, and is [...]y of a place on the shelves of the specialist [...]ll as of the amateur.

[...]AN FOLK-LORE AND ETHNOLOGY.

[...]*lgonquin legends of New England; or, Myths [...]folk-lore of the Micmac, Passamaquoddy, and [...]obscot tribes.* By CHARLES G. LELAND. [...]ton, *Houghton, Mifflin, & Co.*, 1884. 400 p.

[...]*ation legend of the Creek Indians, with a lin[...]tic, historic, and ethnographic introduction.* ALBERT S. GATSCHET, of the U. S. bureau [...]ethnology. Vol. i. [Libr. abor. Amer. lit., [...] Philadelphia, *Brinton*, 1884. 257 p. 8°.

[...]E comparison of languages, if made on [...]ific principles, affords undoubtedly the [...]and indeed the only sure, means of tra[...]the relationship of different branches of [...]uman race. Next to this method, though [...]long interval, comes the study of their [...]s and legends. This study, though infe[...]n the certainty of its deductions to that of comparative philology, has certain evident advantages in other respects. We learn from it the intellectual and moral traits of the people who preserve and repeat the legends. We get to understand their habits of life, their ways of thought, their views of this world, and their ideas of a future life. Occasionally, also, we gather traces of genuine tradition, sometimes even of a far distant past, which, when corroborated by the evidence of language and perhaps other memorials, may be of real historical value.

Mr. Leland has been obliged by want of space, as he tells us, to exclude from his present work the historical legends which he has collected, and which, it is to be hoped, will be hereafter published. His work is thus entirely made up, as its titlepage professes, of what may properly be termed the 'myths and folk-lore' of the eastern or Abenaki branch of the great Algonquin race. As such it must be deemed one of the most valuable as well as most interesting contributions that have been made to this department of knowledge. The collection comprises some seventy stories, distributed under different heads, such as 'Glooshap the divinity,' 'The merry tales of Lox the mischief-maker.' 'The amazing adventures of Master Rabbit,' 'The Chenoo legends,' 'Tales of magic,' and some minor divisions. The whole work shows the hand of an experienced writer, who is at once practised in the literary art, and alive to the requirements of science. The stories themselves display much imaginative power and a genuine sense of drollery. As evidence of intellectual capacity in their framers, some of them will bear comparison with any thing contained in Grimm's Teutonic legends. Mr. Leland is disposed to consider them superior to the legendary tales of the other Indian tribes, but in this view he is certainly mistaken. There is no reason for supposing that the Abenaki Indians surpassed in intelligence the Algonquin tribes of the west and south, or their neighbors of the Huron-Iroquois stock. These, indeed, are known to possess a folk-lore of remarkable extent and interest, which, in the specimens we possess, is not at all inferior to that disclosed to us in the present volume.

The author, in his preface, modestly announces that his chief object has been, not to discuss theories, but to collect and preserve valuable material for the use of better ethnologists to come hereafter, who, as he humorously suggests, "will be much more obliged to him for collecting raw material than for cooking it." This captivating humility, the reader

presently perceives, is merely an exhibition of the highest literary skill, for it preludes the suggestion of the most novel theory thus far propounded in regard to the mythology of any Indian tribe. This theory, which is sustained with much ingenuity and learning, supposes that the myths current among the north-eastern Algonquins are in great part derived from, or colored by, the legends of the Norse mythology. The author assumes that the Norse colonists, who dwelt for three centuries in Greenland, having there at one time as many as a hundred and ninety villages, taught these ancient legends to their Eskimo visitors and dependants, by whom the stories were in turn communicated to their Algonquin neighbors. He points out many resemblances in the personages and incidents of the two mythologies which are certainly remarkable; and he even traces the name of the mischief-making semi-deity Lox of the Abenakies to the evil-working Loki of the Edda tales. At times, however, he finds these resemblances of folk-lore extend to so much wider limits, both in the old world and in the new, that he is disposed to refer them to a far earlier and more primitive intercommunication, prevailing at the time when one pre-Aryan race inhabited both continents.

There is nothing incredible, or indeed improbable, in either theory. Without necessarily adopting them, — and the author himself has not fully made up his mind about either of them, — students of folk-lore may be grateful to any thoughtful fellow-worker who can suggest new lines on which their inquiries may be conducted. They will not, of course, forget the more common explanation, which supposes that similar beliefs may often arise from mere similarity of circumstances. Given the striking resemblance which Mr. Leland himself has well pointed out, between the regions inhabited by the Norsemen and by the Abenakies, and in the character and pursuits of the two races, can we then account for all the coincidences of their folk-lore? Half a dozen resemblances of words, like that between Loki and Lox (which, by itself, may be a mere accident), would suffice to settle this question and to establish Mr. Leland's Norse theory. The decisive value of language as a test in ethnological investigations could hardly be better exemplified than by this statement, the force of which every one will appreciate. Until this test has been satisfied, the author's theory remains only an ingenious and plausible suggestion.

Mr. Gatschet's work, as might be expected from his former publications, is of a purely scientific character; but in this sphere it takes a wide range. It is based on an ancient legend of the Creek or Maskoki Indians, which is partly mythological, and partly historical. This legend, of which the text and translation are given at the close of the present book, is to be more fully elucidated in the forthcoming volume. As it treats of the origin of the Creek nation, and their journeyings from the west, with their wars and other adventures among the people whom they encountered until they arrived at the eastern region in which they were found by the whites, the author has deemed it a suitable basis for a full description, not only of the Maskoki tribes themselves, but also of the surrounding communities. His first or introductory volume thus comprises an account of all the southern tribes of the United States, from the Atlantic seaboard to the western limit of Louisiana, so far as these are known. The history and character of each tribe, and its ethnical relations, are clearly explained. The classification is based on language, which the author justly considers to be the only scientific method. He has devoted much attention to the languages of the Maskoki stock, and gives abstracts of the grammatical characteristics of several of these tongues, which will be of much use to students of philology. The systems of government of the various tribes, their social usages, their modes of warfare, and their religious views and rites, are described with many interesting details. The volume forms a thesaurus of authentic information concerning the southern races, and will hold a high position as an authority on the ethnology of these tribes, and the archeology of the region which they formerly inhabited. The more extended notice which its contents deserve must be deferred until the appearance of the second volume.

RECENT CHEMICAL TEXT-BOOKS.

Traité pratique d'analyses chimiques et d'essais industriels. By RAOUL JAGNAUX. Paris, *Doin.* 1884. 12+503 p. 8°.

The elements of chemistry. By F. W. CLARKE. New York, *Appleton*, 1884. (Appleton's science text-books.) 10 + 369 p, illustr. 8°

Lessons in chemistry. By W. H. GREENE. Philadelphia, *Lippincott*, 1884. (Lippincott's science series.) 357 p., illustr. 8°.

A short text-book of inorganic chemistry. By Dr. HERMANN KOLBE. Translated and edited by T. S. HUMPIDGE. New York, *Wiley*, 1884. 16+606 p., 1 pl. 8°.

AUX's little book treats chiefly of the of minerals, metals, and alloys. Although it is not intended for beginners, according to the author's preface, the details of the processes are often described with great ... nd, moreover, a considerable amount of ... ive chemistry, mineralogy, and metal... introduced, which any practical chemist ... of such information would certainly ... o look for elsewhere in a more complete ... While the methods described are in the ... ose usually followed in certain cases, ... nnot help wondering at the author's ... f method, or at his strange omissions. ... describes for the commercial assay of ... ese only the method of Levol. Under ... l of 'Potash and soda' he mentions no ... r but litmus, directs that this should ... with carbonates and bicarbonates, and ... thing of the convenience of a normal ... solution. For the volumetric deter... n of iron he directs the use of a solution ... ssic permanganate, obtained by fusing ... ic dioxide with potassic hydrate and ... chlorate, dissolving in water, and ... nitric acid until the liquid has a purple ... The author calls attention to the novelty ... in methods, but he gives nowhere any ... on of the accuracy attainable by these ... lder methods; so that the reader is un... judge of their merit without actual trial. ... ry convenient feature of the book is the ... t introduction of tables showing the ... ition of the more common substances, ... tural and artificial.

... is 'Elements of chemistry' Prof. F. ... rke presents briefly but clearly the ... nportant chemical theories, together ... usual amount of descriptive chemis... he student who wishes more extended ... tion will find useful references to larger ... r more special treatises. The hundred ... experiments which are described seem ... ell chosen, and, as a rule, require but ... apparatus and inexpensive material.

... ef sketch of the carbon compounds is ... ced, but the author fails to improve the ... nity thus offered to explain the isom... peculiar to them. Although he illus... p. 307) the structure of certain meta... ompounds, he passes over in silence the ... ce of isomeric propyl, butyl, and amyl ... The fundamental facts of isomerism ... seem more important to the beginner ... e structure formulae of naphthalene, ... ene, pyridine, or chinoline, or the com... of populin, fraxin, phloridzin, aesculin, ... hich he gives.

In the excellent advice to teachers with which Dr. Greene prefaces his 'Lessons in chemistry,' he says that "the object of a limited course in chemistry is not to make chemists of the pupils, but to teach them what chemistry is, what it has accomplished, and what it may accomplish."

This object he has kept steadily in view in writing the book. While many of the more common elements are treated quite fully, he has very properly omitted entirely all description of the rarer elements with which many of the elementary text-books are encumbered.

The space devoted to the compounds of carbon is unusually large. Although the treatment of the subject is necessarily brief, the student cannot fail to get some notion of the broad field upon which so large a number of chemists are now at work.

While we can hardly discuss in detail the facts given, and the method of presenting them, we may say that the old formula of Kekulé for benzol seems quite as well justified by facts as the prism formula of Ladenburg, which he gives, and that by its means the facts of aromatic isomerism are more readily rendered intelligible. We would also note that one or two statements with regard to the higher fat acids are misleading or erroneous.

The plates introduced by Professor Clarke and Dr. Greene, to illustrate spectrum analysis, are such distressing caricatures of nature that they might better have been suppressed.

Dr. Kolbe tells us in the preface to his short text-book that it has been written "to recall to the memory of students who have attended a course of lectures on experimental chemistry, what they have seen and heard," and that in writing it he has adhered to the general principle which should lead the lecturer in chemistry, and that is, "to give to his hearers an idea of chemical processes and the most important chemical theories without burdening their memories with a large number of mere facts." Admirable as this principle may be, it does not seem to have led the author, in this case, to give us any thing particularly novel, at least as far as the descriptive portions of the book are concerned. Its style, it is true, is fresh and entertaining: and yet we can hardly agree with the editor in thinking that it will supply any definite want among teachers or students. Aside from the purely descriptive portion, which certainly is admirable, the book seems to possess a decided disadvantage, in that the necessary theoretical introduction is unsatisfactory. It is true that the editor has done his best to remedy its defects by introducing

into the text brief statements of the laws of Gay-Lussac, Arogadro, Dulong, and Petit, and by adding an appendix upon the determination of atomic and molecular weights. Still, it strikes us that these alterations in the text might have been carried farther with advantage. As it is, the student can hardly fail to be confused by the passage from equivalent to atomic weights; and the book should have recalled to his memory a discussion of molecules and molecular weights in order to make the transition intelligible. The subsequent chapter upon valence makes this omission all the more noticeable.

NOTES AND NEWS.

COMMANDER BARTLETT's annual report on the operations of the U. S. hydrographic office makes a good showing for activity and enterprise. Lists of lighthouses and 'notices to mariners,' in which bearings are given in degrees from true north, instead of magnetic bearings in points, as formerly, have been liberally published; the official correspondence with other hydrographic offices has been increased; and a complete set of the charts issued by all nations is kept on file, and is always at the service of the public for the determination of any questions relating to hydrography. The only vessel engaged in making surveys during the year was the Ranger, on the west coast of Mexico and Central America; but it is strongly recommended that new surveys be undertaken in several regions where they have long been wanted. The charts of the northern coast of South America are mostly based on old Spanish surveys dating back to 1794. 'Watson's rock,' latitude 40° 17′ north, longitude 53° 22′ west, in the path of North-Atlantic traders, has been reported so many times that its existence ought to be definitely settled or unsettled. The recommendation of previous hydrographers with regard to surveys of the Caroline and Marshall Islands, in the equatorial Pacific, should no longer be neglected: they lie in the belt of the trade-winds and westerly current, the natural highway of vessels crossing the ocean to Japan, China, and the East Indies, and require immediate examination. In the North Pacific alone there are over three thousand reported dangers that need decisive observation. In many cases the same island has half a dozen different positions, with as much as fifty miles between the extremes. It is urged that every naval vessel be provided with modern sounding-apparatus, by which even deep-sea measures can be quickly made, and required to sound wherever the charts show no depths reported within twenty miles on any side; and it is desired that a ship should be fitted out expressly to make investigations into ocean temperatures at all depths, and thus obtain data necessary to complete the determination of the actual oceanic circulation.

— In an attractive volume entitled 'Higher education in Germany and England' (Kegan, Paul, & Co.), which may be read through at a sitting, Mr. Charles Bird has given an account of what is done in Stuttgart, Germany, for the promotion of higher education. In a recent visit to the capital of Wurtemberg, it occurred to him to describe the educational equipment of a German town, and to institute a comparison between what is already done in Germany, and what is hoped for in England. All three varieties of high schools, — the gymnasium, the real-gymnasium, and the real-school, — corresponding very closely in their purposes to our colleges and scientific schools, are maintained in Stuttgart; but the university is wanting. There is, however, a *Polytechnicum*, which, as most of our readers are aware, has nearly the same relation to the real-schools as the universities have to the gymnasia.

The book, being written by an expert for a specific public purpose, is excellent reading. Among many things which we might cull, we select a table showing where the school population of Stuttgart may be found. It is estimated that one-seventh of the population, or 17,000 persons, should be under instruction; and of this number, 15,550 are thus accounted for:—

At universities	100
At the polytechnic	350
At the baugewerk schule	600
At the art school	300
At the two gymnasiums	1,300
At the real-gymnasium	900
At the realschule	1,100
At the two girls' high schools	900
At the burger school for boys	1,000
At the burger school for girls	1,000
At the volkschulen for boys	4,000
At the volkschulen for girls	4,000
Total	15,550

Higher than elementary, 7,550; elementary, 8,000.

How would our American towns bear comparison with Stuttgart?

— It is now proposed to carry the railway-trains across the English Channel on steamers; and the London, Brighton, and South coast railway company is having constructed at Glasgow two propellers suitable for the purpose.

— Stenographic notes of Sir William Thomson's course of eighteen lectures at the Johns Hopkins university, on molecular dynamics, were taken by Mr. A. S. Hathaway, B.S., Cornell university, lately a mathematical fellow of the Johns Hopkins university; and these notes, with additions subsequently made by the lecturer, have been carefully reproduced by the papyrograph plate process. A bibliography of the subjects considered will also be given with the lectures. In all, there will be about three hundred and fifty pages quarto. A few copies are offered for sale at five dollars net. The edition is strictly limited to three hundred copies; and orders should therefore be sent at once to the publication agency of the Johns Hopkins university, Baltimore, Md.

— A third series of Johns Hopkins university 'Studies in historical and political science,' comprising about six hundred pages in twelve monthly monographs devoted to American institutions an

s, is offered to subscribers at the former rate,
lars. As before, a limited number of 'studies'
old separately, although at higher rates than
ibers for the whole set. Special announce-
ll be made in December as to the subjects
rly numbers in the third series, for which
ions will now be received. In general it may
hat the new series will include papers on
l municipal government, state and national
ns, and American economic history. The
ited number of complete sets of the first
w remaining in the hands of the publication
f the university, compels the announcement
further subscriptions for that volume can be
at the original rate of three dollars. A few
nd in cloth, will be sold at five dollars net,
iblication agency only. The future interests
ork represented by this journal will require
cy to give preference, in disposing of the
r of the first series, to libraries, specialists,
r patrons who are likely to prove continuous
rs to the 'studies.'

he requisition of the Paris prefect of police,
Dujardin, Beaumetz, Pasteur, and Roux per-
experiments with the view of ascertaining
uld be the best gas for disinfecting rooms in
tients have suffered from contagious affec-
d have come to the conclusion that sulphu-
gas would be the most efficacious for such
; but instead of simply burning sulphur, as
n the barracks and military hospitals, they
nd the burning of bisulphide of carbon as
least expensive, and the least injurious to
ture, or articles of metal, in the room. This
ndation is not new, but it is satisfactory to
tamped with the authority of the distin-
Frenchmen.

ng recent deaths we note the following:
ral, agricultural chemist, editor of Arago's
Paris, in his sixty-fifth year; Dr. J. J.
d, U. S. A., microscopist, well known for his
otographs, at Washington; Dr. Th. Köstlin,
professor of natural history, Sept. 1, at
; Dr. Heinrich Schellen, physicist, author of
-analyse,' 'Magnet- und dynamo-electrische
n,' 'Electro-magneticher telegraph,' etc.,
at Cologne, in his sixty-sixth year; O. J.
, coleopterist, May 28, at Stockholm, in his
hth year; George Brettingham Sowerby,
gist, author of 'Thesaurus conchyliorum,'
t London, in his seventy-second year; Dr.
er, a well-known hymenopterist, Aug. 13,
, in his seventy-fourth year.

Imperial sanitary department at Berlin has
nging for a series of investigations dealing
practical dangers arising from the use of
, in comparison with the point of ignition
y Abel's apparatus. The ignition of gases
to be found above the oil, and the nature
gnitions as are caused by injury to the oil-
or by throwing down the lamps, will also
ention. As all artificial trials of this kind are more or less unreliable in the results obtained, the investigations will deal with the cases of petroleum ignition which have actually taken place. The examination will deal with hanging-lamps, standing-lamps, cooking-appliances, etc.

— The Ainos are distinguished from all the Mongolian peoples surrounding them by their dark complexion, their luxuriant growth of hair, their thick, long beard, heavy mustache, and their European rather than Asiatic features. During his journey in Kamtchatka, Dybowski visited the Island of Saghalin, and took the opportunity of collecting some bones of the Ainos. The following account of the graveyards of the Ainos he sent to Koperniki: —

Unfortunately, almost all the graves have already been rifled by the Russian soldiers, who hoped to find gold and silver buried with the bodies: hence I have found, outside the graves, skulls without the lower jaw. Many, indeed, are broken into small pieces. Very few graves are left entirely undisturbed; viz., those only which are covered with turf, and consequently more difficult to find, and which can hardly be opened without implements; but with these one is not allowed to enter the graveyard, for the opening of graves is forbidden. On account of this prohibition, the search of the graves was made very difficult for me, as I was forced to dig with my hands, or only with a small stick. Fortunately the graves of the Ainos are not deep: they extend north and south, the head buried towards the north. On the right side of the grave, which is covered with turf, are embedded three low pillars about three inches thick and one and a half feet long. On the left side, at the foot of the dead, is found a thin, pointed stick, thrust deep into the earth. The upper end of it is cut in the form of a human head, with two inclined lines running downwards and outwards, as if they were intended to indicate two streams of tears, or perhaps only the eyes. A yard and a half under the sward are found split (not sawn) planks, which rest upon other planks that make the walls of the grave, so that the corpse lies in an empty space. The dead is in the same clothes which he wore when alive, and is provided with the same ornaments which he then carried On the planks over the head of the dead, I have always found three lacquered wooden boxes, and near the feet one large box, also lacquered. On the body I have always found a knife, a tinder-box, a piece of touch-wood, and a pipe.

According to the accounts of eye-witnesses, the religious conceptions of the Ainos appear to be a degenerate and crude feticism. These conceptions are based upon a worship of numerous good and bad spirits or gods, as god of the sun, of the stars, of the sea; worship of the family guardian, of sea and land animals and plants, as also of forest animals. The Ainos have no conception of the continuation of the soul after death, and consequently no service for the dead.

— At the first monthly meeting, Oct. 15, this winter, of the Russian geographical society, the secretary mentioned that the observations of the polar

station at Sagastyr (mouth of the Lena) were ended, and the greater number of the party expected to return this autumn. Only Dr. Bunge staid behind, on account of an entire mammoth, which has been known for some years to exist not far from Sagastyr, and which he was eager to secure. This work, on account of the frozen soil, proved to be a rather arduous task, and he is not expected back until next winter. Leaving seven men of his party at Zaïdam, Prjevalski has started for the sources of the Yellow River. He was expected to return to Zaïdam in August. According to the latest news, Potanin was about to start from Peking, going to Kukuchoto, not by the ordinary road already visited by Europeans, but by Utaë. This place is interesting on account of a Buddhist monastery, a famous place for pilgrimages, and on account of the proximity of mountains said by the Chinese to be ten thousand feet high. The secretary also mentioned the ethnographical travels of three members, — Istourine, who visited Archangel; and Houetz and Wolter, who travelled among the Letto-Lithuanian population of the government of Wilna, Witebsk, and Kowno.

This was followed by a communication on a partial ascent of the Elborus by the mining engineer, Iwanof, well known for his travels in the Pamir in 1883. The natives are convinced that the ascent is impossible; yet the south-eastern summit was ascended in 1869 by Freshfield, Moore, and Tucker; the north-western, by Grover, Gardiner, etc., in 1874; and the western, by Dechy in 1884. Unfortunately these travellers were not scientific men. Russian travellers were less fortunate in their attempts, but their work was more useful to science; for example, that of Muschketone who explored the glaciers on the south-east of the mountains. Iwanof could not ascend farther than 15,700 feet, being prevented by a severe snow-storm. He was obliged to go with his travelling companion only above 13,000 feet, their native porters refusing to go farther, notwithstanding the steepest slopes were below; the gradient from that place upward being very easy, mostly 10° and below. At nearly 15,000 feet, before the snow-storm was reached, the temperature was rather high, —1½° C. Iwanof thinks, that, though access from other directions may be easy, the Elborus will be ascended from the south-east, as on that side there is a considerable population to an elevation of more than 8,000 feet; and thus supplies, porters, etc., may easily be obtained, and the great drawback of mountain travelling in the Caucasus avoided. He mentions especially the assistance which can be obtained here from a native gentleman, Prince Ismael Uruskief, through his practical knowledge of the mountains.

— The *Oil and colourman's journal* for October contains an interesting article on the Scottish mineral-oil trade. It is only about thirty years since James Young began his famous Bathgate oil-works, and only about twenty since the attempt was first made to start shale distilling-works. Now the amount of oil shale brought to the surface daily is about 5,000 tons. The whole of that is distilled for the production of solid paraffine, paraffine-oil, and collateral products yielding at the rate of 50,000,000 gallons of crude oil and 14,000 tons of sulphate of ammonia per annum. From that vast quantity of crude oil there are prepared about 500,000 barrels (each containing 40 gallons) of burning-oil, 30,000 tons (or upwards of 800,000 gallons) of lubricating-oil, and 19,000 tons of solid paraffine. Not less than £2,000,000 has been invested in the Scottish oil-works, most of which yields a handsome return. The annual value of the trade is now about £1,750,000, and the number of persons who directly get their living by the industry cannot be fewer than 9,500. The enormous American oil trade, however, makes skilful working a necessity to the Scotch. Continuous distillation has been the object in view now for many years, and this has at last been obtained through the process patented by Mr. Horman M. Henderson of the Broxburn oil company, which has now been in operation more than a year. Under this process the stills are found to work steadily, continuously, and uniformly. Impurities and heavy oil never accumulate, and the quality of the products is improved. The purified once-run oil is fractionated continuously in a connected series of three cylindrical stills.

— The producers of petroleum on the western shore of the Caspian Sea, it is said, have been seriously contemplating laying a pipe-line entirely across Persia to the Persian Gulf. If this were done, they claim that they would have the Asiatic market to themselves. This pipe-line would have to be something more than seven hundred miles long to reach the coast; and as it would for a long distance pass through a territory of savage Kurds, and other nomadic tribes, it is feared that it could not easily be kept in operation.

— The municipality of Issoudun has resolved to erect a monument to Nicholas Leblanc, the pioneer in the artificial soda industry. A hundred years ago the French government consulted the academy as to the best means of replacing the soda-supply, for which they had been dependent on Spain; and a prize of twelve thousand francs was offered to the inventor of a successful process for extracting the alkali from sea-salt. When Leblanc had fulfilled the conditions of the prize, the academy had ceased to exist: the inventor was obliged to renounce his rights, to close his factory, and to live in the extreme of penury, until finally he committed suicide.

— The council of the re-organized Archaeological institute of America met in New York, Nov. 20, and elected Prof. C. E. Norton of Cambridge, president; Prof. H. Drissler of New York, vice-president; Mr. George Wigglesworth of Boston, treasurer; and Dr. Frothingham of Baltimore, secretary.

— Mr. F. de la Touche, of the geological survey of India, has written a report on the Langrin coalfield, which is situated in the south-west Khasia hills, Assam. Mr. de la Touche says the coal-bearing rocks are exposed over an area of nearly eighty miles, and he thinks there is a large amount of coal available within a short distance of the plains. Limestone is also to be found in many parts of the country, and,

g quarried in the coal season, is taken unamganj, on the Surma River, where it is oles in the river-bank, reeds being used as e lime is finally taken to Calcutta, but an f two years elapses from the time the stone d until it is sent to market. It is suggested, e coal on the spot were used in properly ed kilns, a great saving of the time and ex- would be effected.

French minister of instruction has de- the following scientific missions: Mr. Brau l Lias is sent to Sumatra and Malacca to lections; Professor Guardia, to study the lialects; Mr. Étienne Gautier, to make inves- in natural history and anthropology in 'urkey and Persia; and Professor Henri o study leprosy in Norway.

composition and properties of the light by insects of the Pyrophore genus form the f a paper recently presented to the Paris of sciences by Aubert and P. Dubois. trum of the light, examined by the spec- is very beautiful, but destitute of dark When, however, the intensity diminishes, and orange disappear, and the green and ly remain.

iral Cochrane of the English navy has re- ggested a novel plan for the defence of ves- ommerce from attacks of men-of-war. He that these vessels should be armed with a ortars of considerable range, placed in the ne fifty to eighty feet apart, and so arranged may be simultaneously discharged by elec- The mortars are each to be loaded with a rge of powder; and on this is to be placed t, concussive torpedo of light weight and l, which is to contain a bursting charge of n or other high explosive. The torpedoes connected by a light but very strong line from d to two hundred feet long, the surplus of to be coiled about the torpedoes when in the When the mortars are discharged, the tor- ill diverge slightly, and fall into the water tance apart, where they will float with the een them. If then the man-of-war in pur- inues in a direct path toward her intended will run foul of the line, and the torpedoes awn under her sides, and explode on contact.

e interesting fulgurites have been received ational museum from Whiteside county, Ill. est one found measured two inches in diam- was unfortunately broken in transportation. est specimen of those received intact meas- inch and a half in diameter and four inches . Mr. Abbott, the donor of these specimens, at he traced the tubes to a depth of seven e sand.

assistant surgeon H. G. Beyer, U.S.N., is course of twelve illustrated lectures before l medical society of Washington upon the ent of vertebrate animals.

omewhat novel device for illustrating the microscopic structure of rocks has been brought into use in the geological department of the National museum. A series of photomicrographs was prepared from twelve thin sections of typical rocks, and the former were then thrown upon glass, forming transparencies twelve inches in diameter. The latter were afterwards colored by hand, the artist taking his tints from an examination of the sections themselves under the microscope and in polarized light. The transparencies thus produced are highly artistic in effect, and, on account of their accuracy and attractiveness, must prove an important addition to the educational series of the museum.

— The increasing interest in good methods of library administration is illustrated by a call for a conference of western librarians, to be held at Rock Island, Ill., Dec. 3, and to continue in session during two days. Mr. W. F. Poole of the public library in Chicago is the president and convening officer.

— To supplement the building-stone collection of the National museum in the way of illustrating the adaptability of certain kinds of stone to architectural purposes, a series of photographic negatives of some of the important stone buildings of the country has been obtained, from which enlarged prints (thirty inches by forty inches) have been prepared. These prints have been painted in a manner to show the natural colors of the stone of which the buildings are constructed. Among the prominent buildings represented are the Smithsonian institution, the University of Pennsylvania, the residence of Mr. William H. Vanderbilt (New York), and the Harvard law school (Cambridge).

— It is reported in Berlin that Dr. Koch has succeeded in transferring the cholera bacilli to several rabbits, which have died with all the symptoms of genuine cholera. The priority of success in this experiment is disputed by two Swiss physicians, Messrs. Nicati and Ritsch.

— The Japanese native papers are crying out at the extinction of the lacquer industry of the country. The trees from which the varnish is obtained are disappearing. Formerly, like the mulberry-tree on which the silk-worm feeds, it was protected by law. Each family of the upper classes was obliged to rear a hundred trees, the middle classes seventy, and the lower classes forty. Since this law became a dead letter, the cultivation of the lacquer-tree has rapidly declined. The trees were cut down without care, and none were planted to replace them, so that they have become exceedingly rare, while the price of lacquer has enormously increased. Similar complaints are heard of the process of deforestation going on in Japan since the ancient law, which required every one who cut down a tree to plant two in its place, was abolished.

— A Chinaman, named Chen-Ki-Souen, has written a monograph on the famous Chinese ink, commonly known as India ink, from a translation of which the *Oil and colourman's journal* prints the following abstract. The Chinese writer describes every stage of the preparation of India ink with great accu-

racy and elaborate detail. The author states that a kind of pigment ink was discovered somewhere between 2697 and 2597 B.C. It was employed for writing on silk with a bamboo rod. Afterward an ink was prepared from a certain stone, which is still known in China as Che-hei. It was not until about 260 B.C. that they began to make an ink from soot or lampblack. The soot was obtained by burning gum-lac and pine wood. This ink was made first in round balls, and very soon supplanted the stone ink. For a considerable period the province of Kiang-Si appears to have had a monopoly of ink-making. Under the dynasty of Tang, 613 to 915 A.D., there was a special officer, called an inspector, who had charge of its manufacture. He had to furnish the Chinese court with a certain quantity of this ink annually. Some of the factories seem to have been 'Royal Chinese' factories. The emperor Hinan Tsong (713–756 A.D.) founded two universities, to which he sent three hundred and thirty-six balls of ink four times a year. The most celebrated factory in China is that of Li-Ting-Kovei, who lived in the latter part of the reign of Tang, and made an excellent article. He made his ink in the shape of a sword or staff, or in round cakes. The test of its authenticity consisted in breaking up the rod, and putting the pieces in water: if it remained intact at the end of a month, it was genuine Li-Ting-Kovei. Since the death of this celebrated manufacturer, there seems to have been no perceptible advance made in the making of India ink. In the manufacture of lampblack, nearly every thing is used that will burn. Besides pine wood, we may mention petroleum, plant-oils, perfumed rice-flour, pomegranate bark, rhinoceros horn, pearls, and musk. Nor does fraud seem to have been entirely wanting. According to the best Chinese authorities, the best India ink smells like musk, and the addition of musk not only serves to give poor goods the resemblance of finer ones, but also actually makes them more serviceable. The binding-agent is the most important ingredient next to the lampblack. In former times glue made from the horns of the rhinoceros and of deer was employed: now only ordinary glue and isinglass are used. Good Chinese ink improves with age, and should not be used until a few years after it is made, but must be entirely protected from moisture. In using, it should only be rubbed backwards and forwards, as, for some unexplained reason, rubbing it round and round hardens it.

— D. Wedding, says the *Athenaeum*, has been making experiments showing that the capacity for welding increases with the amount of silicon present, and decreases with any excess of manganese. The latter acts by interfering with the crystalline structure of the iron, and confirms Ledebur's idea that all adventitious bodies influence welding in proportion to their amount.

— Capt. Walker of the steamship Para at Philadelphia, Nov. 17, reports that on two successive occasions he thinks his vessel was saved by the use of oil. In one instance he was running before a heavy gale in the Formosa Channel, China, and the sea was remarkably high. His vessel was in great danger of being pooped, as she was coal laden and very deep. He concluded to try oil, and hung two canvas bags upon each quarter. Sufficient oil oozed through the canvas to answer his purpose, and the sea ceased breaking at once. Only four or five gallons of oil were expended in twelve hours.

Capt. Petersen of the Norwegian bark British Queen reports that about one year ago he commanded a vessel which was trying to make the port of Valencia, Spain, in heavy weather. Just before making the breakwater, the wind hauled ahead, and he was forced to let go his anchor. The storm increased, and seas swept over the vessel fore and aft. He lowered a canvas bag of oil from the jibboom, and the seas no longer broke over the vessel.

— The students of Berlin university have organized a new association among themselves, — a society of students of the science of dentistry. They have added the American stars and stripes to their banner in acknowledgment of the debt this science owes to the United States.

— Mr. Spence Paterson, British consul at Reykjavik, writes to the London *Standard* that on Sept. 9 he visited Cape Reykjanes, the south-west point of Iceland, in order to observe the volcanic island which recently appeared off that cape. It was first seen by the light-keeper at Reykjanes on July 29, and had then the shape of an irregular truncated cone, with a slight hollow on the top, and a projecting shoulder on the north side. No earthquakes or other volcanic manifestations accompanied its appearance; but on Aug. 5 a series of severe shocks occurred, which split the walls of the lighthouse, and damaged the lamps. For several days rain and fog obscured the island. When next seen, its shape had altered: part of the south side had fallen down into the sea, forming two little mounds, and leaving a steep, almost perpendicular face on the south. The height of the island is about two-thirds of its length. It lies about west-south-west of Reykjanes. Two officers of a French war vessel, who recently visited Reykjanes, estimate its distance from the coast at nine or ten miles, but Mr. Paterson believes it to be considerably greater. When first seen, the upper part of the island was perfectly black; but it has now begun to whiten, owing to the droppings of the myriads of sea-fowl which frequent the adjacent coast and neighboring islands, and seem already to have taken possession of the new land. The neighborhood of Reykjanes is noted for volcanic manifestations. Islands have from time to time risen and sunk there: and only a couple of years ago a violent eruption occurred near the spot where the new island lies: columns of smoke and steam rose out of the sea, and large quantities of pumice were thrown up, and floated ashore on the neighboring coast. *Nature* of Nov. 13 gives pictures of the past and present appearance of the island.

— Dr. Finsch, the German explorer, left Sydney in the Samoa on Sept. 10, to explore the Phoenix and Union Islands.

SCIENCE.

FRIDAY, DECEMBER 5, 1884.

OMMENT AND CRITICISM.

AL QUESTIONS of importance, affecting ntific work of the government, will efore congress during the session just First among these will be the organ- of the two great surveys and of the ervice. Our readers have already been d through this journal, as well as through spapers, that the question of the man- t of these bureaus was referred to a sional commission, composed of three and three representatives, who are re- by law to report their conclusions, by therwise, on or before the third Monday ember. This commission invoked the the National academy of sciences, and rt from a committee of this body is in the hands of the commission. The ions of this report have not been tatively made public; but, according to paper account, it recommends nothing adical than the concentration of the in question under a single department government, and the appointment of a sion to control the policy both of the nd geological surveys.

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is naturally expected that the commis- ould itself enter upon a thorough and investigation of the subject, — a view was strengthened by the fact that a was called for Nov. 11; but, up to sent time, there are no indications that mission is going to enter upon any very labors. Only one week will remain hen these lines reach our readers, and e not been able to learn that it has done ng but postpone its meetings. In this reflects the natural tendency of the s whose term is about to expire. A ession is, under any circumstances, unfavorable for new legislation, and the house would naturally be inclined to await the views of the incoming administration before adopting any measures which might hamper it. We must also remember that it is much easier to stop a bill than to pass it, and that we can hardly expect a measure to be devised which will command the unanimous approval of all concerned. The establishment of a bureau of electrical standards, as proposed by the electrical congress at Philadelphia, must take its chances with the measures for re-organization of the surveys. There is no likelihood of an independent measure for such a bureau being successful.

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Other matters which may be expected to arise are international in character; namely, the legalization of the conclusions of the Paris electrical conference and of our own meridian conference. In both these matters we can only hope that congress will make haste very slowly. There is no apparent pressing reason for speedy action on either subject, since both might very well take care of themselves without legislation; and there is a chance of much harm being done by too hastily adopting conclusions which may soon be found to need revision. The standard of light of the Paris conference has not been shown to be realizable in practice, and the accuracy of its ohm is already being called in question. In the case of the meridian conference, so far as its conclusions define the counting of longitudes from Greenwich, they merely authorize our universal practice, and there is hardly more need of our legislating upon the subject than there is of enacting that people shall eat their dinners. If its universal day is found convenient, it will come into use of itself; if not, congress ought not to legalize it. Altogether, we do not see much prospect of very good measures being devised between now and the 4th of March; and we may as well, therefore, reconcile our-

selves to the prospect of nothing being done beyond the passage of the regular appropriation bills.

THE RAPID increase of an organic species in a new and favorable habitat has been illustrated by Darwin's description of the cardoon, that so quickly spread over the Argentine pampas. A more recent example of similar success on the part of a colonizer is seen in the English sparrows that have become so numerous around our eastern cities; but the most peculiar illustration of the effect of better opportunity on an old form is found in the rapid development of seismometric instruments in Japan. The instrumental observation of earthquakes has had but moderate advance in Europe of late years: earthquakes are too rare there to give the study sufficient nourishment for development much beyond its present stand. But the English and German professors imported a few years ago, by the Japanese government, to build up the University at Tokio, found the numerous light shocks in that country to be just the stimulant needed for the rapid multiplication of seismometers; and as a result the European stock [illegible] there has sprung up in such numbers [illegible] and perfection as to [illegible] its rel- [illegible]

[illegible] few [illegible] in [illegible] instead [illegible] of seis- [illegible] ex- [illegible] of [illegible] of [illegible] [illegible] the [illegible] of [illegible] ssor Ewing's recent work on earthquakes, printed by the Japanese government, the date is given as '2543 (Japanese era). 1883 A.D.' In a matter of chronology, where, to avoid confusion in dates, a uniform system among all nations is the great desideratum, it would seem almost superfluous to suggest the advisability of dropping from the works which the Japanese publish in foreign languages the use of an era which has never been employed in either business or official correspondence or records by the Japanese themselves, which was invented and officially adopted only twelve years ago, and which, though claiming to reckon from the time of the accession to the throne of the first Japanese emperor, has no reliable historical basis whatever, for at least the first twelve or thirteen hundred years, perhaps more, of its claimed antiquity.

IN A NOTICE of the first annual report of the New-York experiment-station (*Science*, vol. ii. No. 42) we took occasion to point out what appeared to us to be the mistaken view of its director regarding the duties of an experiment-station. It would seem either that our apprehension of his meaning in the preliminary passages of that report was imperfect, or that time and further experience have led to a revision of opinion upon the point in question. On p. 22 of the present report we find the following: "Before much real practical advance can be made in bringing agricultural pursuits within the domain of applied science, much work of a purely scientific character must be accomplished; and unpopular as it may be for the worker, yet that worker who investigates agricultural problems, not from the economic but from the reason stand-point, is doing the best work, and the work which in the end will be found most profitable in its applications." We quote this paragraph because it so well expresses the opinion which we urged in our review of the first report, that an experiment-station is primarily a scientific institution, intended to promote the advancement of the science of agriculture, and capable of the high-

most permanent usefulness, only when this intention as far as possible.

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ther the words we have quoted, and of a similar tenor, mark a change of on the part of the director of the New-tation, or are only a clearer expression rictions previously held, we do not un- to say. In either case, we are glad the weight of this important institution favor of the scientific conception of an nent-station. The great need of agri- to-day is not new varieties of plants, roved breeds of animals; new methods ivating the soil, or improved systems of g. All these, and many other like are good; but the two great wants etter knowledge of principles, and great-ligence to apply them. For the latter st look to our agricultural schools: the we should require from our experiment-s.

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do not hold that an experiment-station never undertake to originate or test arieties of plants and animals or new tural methods, — often work of this gen-aracter will be demanded of it by the and will prove of great public utility, — our view, it should not be allowed to to appear to be, the chief end of the . The two kinds of work are both ant, but we question the advisability of ting to unite them in one institution nder one management. Each requires s and talents peculiar to itself; and it doubtful, whether, as a rule, one insti-will be able to provide good facilities for nds of experimentation, and still more il whether it can find combined in one the diverse knowledge and training re- for their successful prosecution. With owth of agricultural experimentation night profitably be, we suspect, in the y of cases, a subdivision of it into erlapping yet independent classes. We have, first, the experiment-station prop-ning chiefly at a further elucidation of the laws and principles underlying agriculture; and, second, the experimental farm, devoted mainly to carrying out upon a farming scale the principles worked out by the experiment-station.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

Psychical research.

YOUR issue of Oct. 17 contained two articles which are of good omen for the future of 'psychical research' in America. Of the first, the editorial article, I need say little. It is cordially welcomed by my colleagues and myself for its recognition of the far-reaching importance of an enterprise in the further development of which our society will, we hope, go hand in hand with yours. With the second article, on 'psychic force,' our agreement is less complete; but we still find nothing to complain of in the general attitude of the distinguished writer. He, too, recognizes the legitimacy of the inquiry, while clearly apprehending its difficulties. He describes with entire justice the two opposed classes between which psychical research has to clear a path, — the party of easy credulity, and the party of easy incredulity; and he points out with no more than proper emphasis the rigorous caution which every forward step demands. Fraud and superstition have naturally seized on what science has so systematically neglected; and those who now endeavor to take the subject up from the scientific side must accept the fact and its consequences.

So far, then, we are wholly at one with Professor Newcomb; but we cannot quite so readily follow him in his criticisms of our own doings. He begins by condemning one of our public appeals for information; but his strictures seem to assume that all the information which the appeal brings in will be regarded by us as a safe basis for conclusions. The appeal is, of course, merely a first step, for which it would be difficult to imagine any effective substitute; though I may mention that a very large amount of our information comes to us through private channels. The sifting and treatment of the evidence according to scientific canons must be a subsequent labor, the *rationale* of which could not be set forth, or even suggested, in the terms of a short advertisement. And of this labor no portion is more important than the one which we are glad to find Professor Newcomb so explicitly recognizing, — the application of the doctrine of chances. In all those branches of our inquiry where questions of *coincidence* occur, it is clearly essential to ascertain, as definitely as may be, how far the coincidences may fairly be ascribed to *chance*. We have taken, and are still taking, great pains to obtain this definite information. Very wide inquiries have been made; and the results, though far from complete, may still, I think, claim decidedly more validity, as a basis of computation, than Professor Newcomb's guess at what "any physician will consider quite within the bounds of probability." It would require more space than I can ask for, to comment on Professor Newcomb's numerical argument in detail. But I may remark that he seems to confuse the argument by classing all together what he calls 'dreams, illusions, visions,' etc.; at least, if

he means to include in this heterogeneous group visual hallucinations of waking persons, which we regard as by far the most important phenomena from an evidential point of view. If any one, in his waking moments, experiences apparitions of human forms as often as once a week, which is the degree of frequency that Professor Newcomb's calculation assumes, it is obvious that the approximate coincidence of one of these apparitions with the death of the corresponding human being will be an insignificant accident. But we have not ourselves met with any specimen of this class. We have collected more than a hundred first-hand cases of apparitions closely coinciding with the time of death of the person seen; and it is only in a small minority of such cases that our informants, according to their own account, have had any other hallucination than the apparition in question.

The following sketch may serve to show the lines on which our own reasoning in the matter will proceed. We are making a census, which, so far, shows that in this country the proportion of sane persons, in good health and awake, who within the last ten years have had a visual hallucination representing some living person known to them, is about one in three hundred. Now, let us make a supposition far below the actual mark, and confine the number of the acquaintances of each of these hallucinated persons to five. Let us further suppose that one of these five persons does actually die in the course of the ten years. This seems fair, on the whole; for, though in some cases more than one may die within that time, in others none may die. According to this estimate, then, the chance that the death will take place within twelve hours of the apparition will be one in $365 \times 2 \times 10 \times 5$; that is, one in 36,500: in other words, only one out of every 36,500 of the hallucinated persons will, in the course of ten years, hit off the coincidence by chance. But since the hallucinated persons are only a three-hundredth of the whole population, this means that the proportion of the whole population who will by chance have an apparition of a person known to them within twelve hours of that person's death is only one in 10,950,000. Now, we ourselves have a large collection of such recent cases, resting on good first-hand testimony; but let us put the number far below the mark, and say thirty cases. If, then, these thirty coincidences are to be fairly attributed to chance, the population of the country will have to be 328,500,000. But we cannot suppose that our appeal for evidence has reached the whole population; and we shall be making a sober estimate, if we reckon that within the given time ten times as many cases must have occurred as those we happen to have encountered. This brings the necessary population up to 3,285,000,000; and the number will be further immensely increased if we take count of the fact that many of the coincidences are extremely close, that the times of the two events fall not only within twelve hours, but within one. Thus the theory that chance would account for the cases could only be justified if the population of the country were several hundred times what it actually is. The *reductio ad absurdum* seems tolerably complete.

The case of dreams is of course very different. We are most of us constantly dreaming. A very large number of 'odd coincidences' between dreams and external events is certain to occur by mere chance, and the cases are rare where the correspondence is of a kind which strongly suggests telepathic influences. Here, therefore, Professor Newcomb's estimate is far more applicable; and we have always felt that dreams, by themselves, could not be expected to afford conclusive proof of telepathy. This, however, does not seem a sufficient reason for ignoring them; since, if the fact of telepathic communication be otherwise established, they may throw light which we could ill afford to neglect, on the nature of the mental and cerebral processes involved.

As regards 'haunted houses,' we readily admit, and have expressly pointed out, the far greater uncertainty of the evidence as compared with the best telepathic cases. But even here we differ from Professor Newcomb in seeing a distinction between the experiences which we deem of some *prima facie* importance, and the experience which he supposes when a person, lying awake an hour after midnight, hears some sound the cause of which is beyond his power to guess. Sounds are the very weakest sort of evidence. What strength the *prima facie* case has, depends, not on things heard, but on things seen; and seen, not by one person only, but by several independently and at different times, and, as the seers affirm, without any knowledge, on their part, that the house was supposed to be 'haunted.'

Professor Newcomb's concluding remarks, dealing with the *experimental* side of telepathy, deserve careful attention. But his objections here rest entirely on the hypothesis of visual and auditory indications consciously or unconsciously given by the 'agent' to the 'percipient;' and though it is difficult, I know, to convince persons who have not been present that sufficient precautions have been taken to eliminate this source of error, it must surely be admitted that such precautions are possible. As regards sight, no one will deny the possibility; and, as regards hearing, we think, that, if a careful watch is kept, the means of communication resolve themselves into slight variations of breathing. Such variations were never detected in our experiments, and in any case could hardly be supposed capable of rapidly conveying to the percipient's mind the form of an irregular diagram; and the difficulty would be increased in cases where the signs would have had to be *unconscious*, as in many of our experiments where we were able not only to vary the 'agent,' but to act ourselves as 'agents.' As for 'indications whether the subject is going right or wrong,' they must, of course, be prevented by taking care that the 'agent' shall not watch what the 'percipient' is doing. Most of the spurious 'thought-reading' of the 'willing-game' would be prevented, if the 'willer,' instead of the 'willed,' were effectively blindfolded.

But we find ourselves once more wholly in sympathy with Professor Newcomb, when he insists that the experiments must be repeated again and again, under the strictest conditions, before we can reasonably expect thought-transference to be accepted as an established scientific fact. So far from resenting the demand for more evidence, we are ourselves unceasingly reiterating it. The responsibility for such novel observations cannot be too widely spread, and glad indeed shall we be to shift some of it to American shoulders. EDMUND GURNEY,

Hon. sec. of the Society for psychical research.

14 Dean's yard, Westminster, S.W.,
Nov. 4.

Mr. Gurney's letter suggests many interesting reflections on the probabilities involved in questions of telepathic phenomena, and I hope for an early opportunity to engage in a further discussion of the subject in the columns of *Science*. This will naturally involve the consideration of the points raised in his letter. Meanwhile there are two numerical data:

ie would favor me with them, I should feel ttered, — firstly, his estimate, from the census of the number of persons of the age of fifteen vards, resident in the British Islands, whose nts he would consider *prima facie* entitled redence (to guide him I may remark that I reason why the number should not be from venty millions); secondly, his estimate of the lity that one of these persons, taken at ran- ould not be above amusing himself or herself xpense of a society so eminent as that of which rney is the honorary and honored secretary. umbers will come into my discussion, and I much rather have them from an authority ant with the subject than attempt to guess at yself.

SIMON NEWCOMB.

Change in the color of the eye.

xperience of Mr. T. F. McCurdy (p. 452) is, ne, a not uncommon one. It certainly finds ion in my own family and in myself; the iris, was quite black in childhood, having for many sibly lightened, until it is more correctly de- as gray, with shades of hazel. The fading-out k eyes with age is a matter of common obser- and the change, judging from the facts within knowledge, is more apt to occur where the ual takes after a grandparent who had the ve, and where the immediate parents had blue .

C. V. RILEY.

ngton, D.C.

nens illustrating Lehmann's 'Origin of the crystalline schists.'

ay not be uninteresting to the geological read- *Science* to know that the writer has recently d, through the kindness of Professor Johannes nn of the University of Breslau, a very valua- e of rock specimens illustrative of the latter's d important work on the origin of the crystal- ists, noticed in *Science*, No. 86, p. 327, and in *erican journal of science* for November, 1884.

These specimens are sixty-three in number, re collected, partly by Professor Lehmann him- d partly under his immediate supervision, in anulite area of Saxony, and in those parts of a which he has made the subject of his special They exhibit in an excellent manner nearly se phenomena ascribed by the author of the memoir to metamorphism by pressure, espe- however, the changes which certain massive ne rocks of Saxony have undergone in becom- nblendic schists exactly analogous to similar ions traced by the present writer in the rocks altimore.

ll students of metamorphism and of structural in highly crystalline regions, this work must absorbing interest as undoubtedly the most ed of its kind; and, in spite of its superb atlas st satisfactory photographic illustrations, its may be glad to know that this suite of origi- ecimens is in the petrographical laboratory of hns Hopkins university, where it will always essible to such persons as may be interested in ing it.

GEO. H. WILLIAMS.

nore, Nov. 25.

Bot-flies in a turtle.

days ago Prof. T. Robinson of Howard uni- called my attention to a box-turtle (Cistudo carolina) which had in the muscles on either side of the neck about thirteen large bot-fly larvae. The turtle was alive, but evidently suffered inconvenience from the intruders which had taken up their abode at a point from which they could not be dislodged by claw or beak. They were removed with forceps, and sent to Mr. Howard of the agricultural bureau, who informed me that they belonged to the family Oestri- dae, and to a genus probably undescribed. He also brought to my attention an exactly parallel case re- ported in the *American naturalist* (xvi. 598) about two years ago by Prof. A. S. Packard.

FREDERICK W. TRUE.

U. S. national museum, Washington, Nov. 24.

On the function of the serrated appendages of the throat of Amia.

Through the kindness of Prof. B. G. Wilder I have at present two living specimens of Amia which I pro- pose to employ shortly in a comparative study of the brains of American ganoids.

My attention was first attracted to the serrated appendages of the throat by Professor Wilder's own note upon the subject, published in the *Proc. Amer. assoc.*, 1876, and more recently by a reference to the same structures in one of Sagemehl's admirable con- tributions to the anatomy of fishes (*Morph. jahrb.*, x. 63). Sagemehl concludes, from the examination of alcoholic specimens, that these 'flagella' are, during life, in constant motion, and thus help to renew the water in the gill-cavity. Such is by no means the case. The 'flagella' are attached by their bases to the lateral aspects of the sterno-hyoid muscles (hyo- pectorales of McMurrich), the chief function of which is to enlarge the cavity of the mouth. When these muscles are at rest, the flagella lie flat along their surfaces: when they contract, the cavity of the mouth is enlarged, the flagella erected, and the gill- covers pushed outwards. At the suggestion of my assistant, Mr. A. B. Macallum, we stimulated the prox- imal part of the muscle with the result of a perfect demonstration of the above facts. The flagella thus help to replace functionally the absent dilatator mus- cles of the gill-covers. A strip of condensed tissue occupies a precisely similar position on the hyopec- toral muscle of Amiurus, perhaps a rudiment of similar organs possessed by the ancestors of the silu- roids before the differentiation of the dilatator mus- cles of the operculum.

My specimens of Amia, after being in captivity for some time, became very sluggish, and hardly any movements of respiration could be detected. After the fish had been removed for a little out of the water, however, and then returned to it, the move- ments were sufficiently active to disclose the follow- ing facts: —

During the enlargement and filling of the cavity of the mouth, the posterior flexible (and muscular) bor- der of the gill-cover is tightly applied to the soft parts behind the gill-opening. When the mouth- cavity is quite full, the mouth closes, the muscular border of the gill-cover releases its sucker-like hold of the soft parts, and the water is driven out by the contraction of the walls of the mouth-cavity.

Professor Wilder's account of the structure of the serrated appendages is so complete as to render any further reference to this subject unnecessary.

R. RAMSAY WRIGHT.

University college, Toronto, Nov. 27.

Ergot nectar.

During the past summer I received a kind of grass from several of the northern states, which was sent me under the name of manna-grass. It proved to be Glyceria fuitans. It was stated that the bees were gathering large quantities of very delicious honey from this grass. I could readily believe the report, as the grass was covered with small crystals, as if it might have been wet, and dipped into granulated sugar. This sugar was very sweet and pleasant; and I have no doubt, that, like the nectar from Aphides, it would be wholesome winter food for bees, and no injury in honey for the market. The bees expressed the same opinion, as I learn that they would not leave this grass even for clover or linden bloom.

Upon examination, I found that the grass was covered with ergot grains, and that the nectar was a secretion from this poisonous fungus.

We see, then, that even the poisonous ergot, which I believe some of our best veterinary scholars think caused the so-called 'foot and mouth disease' among the cattle of Kansas last winter, has its wholesome uses. Why the ergot secretes this pleasant sweet, is hard to answer. The nectar, doubtless, serves the fungus in some way.

A. J. Cook.

Agricultural college, Michigan, Nov. 25.

THE 'OLD STONE MILL' AT NEWPORT.

Finding myself in Newport lately, I took occasion to make some measurements upon that old circular building about whose origin (whether English or Norse) there has been so much dispute. I have not the slightest title to an opinion upon that subject, in which I have only a metrological concern. The building is circular, and rests upon eight cylindrical pillars. It is of such a size that any one would say, before measuring it, that the pillars would be circumscribed by a circle of four yards radius, and inscribed by one of three yards radius. The building could not have been erected without a drawing to scale, so that a unit of length must have been employed, and that unit (whether Norsemen or English were the builders) would undoubtedly be a foot. The Icelandic foot was, I take it, the same as Denmark and the Scandinavian countries used up to the adoption of the metric system; that is to say, it coincided with the Prussian foot of 12.36 inches English.

I found the diameters of the structure, measured at the pillars, as follows: —

From outside to outside of the shafts.	Between the inward sides.
24 feet 8 inches.	18 feet 6 inches.
24 " 8 "	18 " 5 "
24 " 9 "	18 " 4 "
24 " 7 "	18 " 5 "
Mean . . 24 feet 8 inches.	Mean . . 18 feet 5 inches.

I think there can be little question that these lengths were meant to be 24 and 18 of the feet used. But supposing that I ought to have gone, say, farther out for the outer diameter (for instance, as far as the bases of the pillars extend), then I ought to have cut off the internal measure by the same amount; so that the mean of the two measures that I have taken is almost certainly 21 of the original feet. This mean is 21 feet 6½ inches, which, divided by 21, gives 12.31 inches as the length of the foot used. Besides the two lengths just mentioned, I found no other of sufficient magnitude, which I could conveniently measure, except the heights of the pillars. These appear to be intended to be 8 feet from the top of the base to the upper side of the cap-stones. The latter are 6 inches thick, as well as I could judge, leaving 7½ feet for the height between the base and capital. This could readily be measured with a tape-line, and was measured [1] on the insides of the pillars at two places on each pillar, — one at the right, and the other at the left. The following are the results: —

North arch.	East arch.	South arch.	West arch.
7 ft. 7 in.	7 ft. 8 in.	8 ft. 2 in.	7 ft. 7¼ in.
7 " 5 "	7 " 8¼ "	8 " 2 "	7 " 8 "
North-east arch.	**South-east arch.**	**South-west arch.**	**North-west arch.**
7 ft. 7½ in.	7 ft. 9 in.	8 ft. 0½ in.	7 ft. 6 in.
7 " 8½ "	7 " 8 "	8 " 0 "	7 " 8¼ "
East arch.	South arch.	West arch.	North arch.

The mean of these is 7 feet 8⅜ inches; but the two south-west pillars are so different from the others, that I think it is more satisfactory to adopt the middling heights. Excluding, then, the two highest and two shortest pillars, the others measure

	7 feet 8 inches.
	7 " 8¼ "
	7 " 8½ "
	7 " 7¾ "
Mean . .	7 feet 8⅛ inches.

We have, then,

	Outer diameter.	Inner diameter.	Height.
Presumed intentional measure,	24 ft. 0 in.	18 ft. 0 in.	7 ft. [illegible]
Same in English feet, if foot used was 12.31 English inches,	24 " 7.4 "	18 " 5.6 "	7 " [illegible]
Same, if foot used was the Scandinavian foot of 12.36 English inches,	24 " 8.6 "	18 " 6.5 "	7 " [illegible]
Observed	24 " 8 "	18 " 5 "	7 " 8¼ " 7 " 8.[illegible] "

I made some other measures, which, though I think them of no value for determining the value of the foot, I proceed to give.

[1] The tape-line is believed to require about half an inch negative correction for all the measures. This has not been applied, as I have been unable to obtain the tape to verify the correction. In any case, such a correction is negligible in measuring so rough a structure.

[...]ts of the pillars on the outside.

7	feet	$3\frac{1}{2}$	inches.
7	"	2	"
7	"	4	"
7	"	6	"
7	"	3	"
7	"	10	"
7	"	7	"
7	"	5	"

[...]n . . 7 feet $5\frac{1}{8}$ inches.

Circumferences of the pillars.

10	feet	$1\frac{1}{2}$	inches.
10	"	2	"
10	"	0	"
9	"	9	"
9	"	$9\frac{1}{2}$	"

Mean . . 9 feet 11.6 inches, giving diameter, 3 feet 2.1 inches.

Sockets for jambs below.

Breadth . . .	0 ft. $4\frac{1}{4}$ in.
Height . . .	0 " 4 "
Depth	0 " $2\frac{1}{2}$ "

Original height of frame, 2 feet.

South-west niche.

Breadth . . .	1 ft. 6 in.
Height	1 " 3 "

West window.

Breadth . . .	2 ft. 2 in.

Higher socket.

Breadth . . .	1 ft. 6 in.
Height	1 " 4 "

[...]eters of bases of columns (most regular).

3	feet	10	inches.
3	"	$9\frac{1}{2}$	"
3	"	$9\frac{3}{4}$	"
3	"	10	"

[...]n . . 3 feet $9\frac{3}{4}$ inches.

[...]rcumferences of bases.

12	feet	2	inches.
11	"	9	"
12	"	1	"
12	"	2	"

[...]n . . 12 feet $0\frac{1}{2}$ inches,

[...]ponding [...]iameter, 3 " 10 "

Fireplace.

Breadth . . .	3 ft. 5 in.
Height	4 " 0 "
Breadth at base,	2 " 7 "

Niche on the right of fire-place.

Breadth . . .	2 ft. $3\frac{1}{2}$ in.
Height . . .	2 " $1\frac{1}{2}$ "

Small niche or socket on south side.

Breadth . . .	1 ft. $6\frac{1}{4}$ in.
Height . . .	1 " 8 "

South window.

Height outside,	2 ft. $5\frac{1}{4}$ in.
Breadth . . .	2 " 2 "

My ladder was too short to enable me to measure the upper parts.

Without wishing to express any archeological opinion whatever, I cannot refrain from saying, that, as far as I could perceive, all the rough-cast covering the walls, the smooth mortar in the sockets, etc., were a part of the original mortar. There is a certain amount of later mortar, but it is readily distinguished upon close inspection.

The fireplace has two flues; and the windows formerly had frames, as if for holding glass. The projections of the pillars beyond the upper part of the tower suggest that there might have been a ledge upon which a miller could climb to turn round the axis of the sails of

the wind-mill. The two separate flues to the fireplace might prevent the draught from being interfered with by the axle. But would not a fire in a grist-mill be dangerous?

The hearth of the fireplace was elevated above the floor, as in a forge. The building had two stories above the ground. Its total height is about twenty-five feet.

The stones, many of them granite, show no drill-marks and no marks of an axe, but do show marks of the hammer. C. S. PEIRCE.

THE 'HOOD' OF THE HOODED SEAL,[1] CYSTOPHORA CRISTATA.

ALL THE figures of the hooded seal which I have seen represent the animal with a great bunch on the top of its head. This bunch is made to vary somewhat in shape, size, and position, in the different illustrations; but all agree in placing it on top of the head, no part ever protruding beyond the jaw. It is sometimes pictured as extending transversely across the crown, sometimes as a double or single roll reaching from the nose to the occiput. The earliest delineation of it which has fallen under my observation is that given by the old missionary, Hans Egede, in his description of Greenland, published in 1741 (fig. 1). Crantz, who was also for many years a missionary in Greenland, said, "The forehead is furnished with a thick folded skin, which the animal can draw over its eyes like a cap, to protect them from stones or sand driven about by the surf in a storm." And even Dr. Rink, in his recent excellent work on Danish Greenland, says that this seal 'is well known from the bladder on its forehead.' In Griffith's

FIG. 1.

ıvier' it is stated that the hooded seal "has ɔwer of bringing a fold of skin placed on -head, forward, so as to cover the eyes, Mean .does when threatened, or about to be struck. . . . When at rest, or drawn back, it considerably enlarges the apparent size of the neck and shoulders." The only adult hooded seal, so far as I am aware, possessed by any museum in America, is in the American museum of natural history at Central Park, New York. Its head is very well represented in the accompanying drawing (fig. 2).

FIG. 2.

Determined to visit the seal-fishery in person, I set sail from Halifax in February, 1883, proceeding northward from Newfoundland in the cabin of the ill-fated Proteus, in her annual cruise to the sealing-grounds. On the 18th of March, after a somewhat laborious walk over an ice-floe, I found myself face to face with a family of hoods, and discovered that the male, — a huge beast, bigger than an ox, — instead of having a crest, or fold of skin, on the top of his head, was provided with a great proboscis, suggesting that of the sea-elephant of the antarctic (fig. 3). He looked on with apparent indifference, while his mate, solicitous for her young, advanced to meet me, growling fiercely, and displaying her sharp, curved teeth. Wishing to observe her actions, I annoyed her for a few minutes with my gaff, — a proceeding which it is by no means safe to undertake with the male. While this encounter, in which she was the aggressive party, was in progress, her spouse began to manifest symptoms of uneasiness, and finally became very much enraged, though he did not attempt to drag his ponderous body to the scene of the conflict. He at first showed his displeasure by frowning, and wrinkling the skin on his long snout. The tip of the proboscis was then inflated and emptied several times in rapid succession, after which the entire 'hood' was partially inflated. In

I think

lengths we

[1] (a paper read before the Biological section of the ...ation, Sept. 9, 1884.

on to its numerous and ever-changing ctions, there was one rather constant iction about opposite the nostrils, in-etely dividing it transversely into two ns, the anterior of which, though dark in much resembles a bladder, and explains ulgar epithet, 'bladder-nose,' often ap-o this species. A curious fact observed hat, during the alternate filling and emp-of the sac, a noise was produced which y resembled that of bubbles of air rush-to a bottle from which a liquid is being l. It was a loud, gurgling sound, audi-a distance of twenty-five metres or up-. On approaching nearer, the animal e furious. He inflated his 'hood' to n extent that all traces of constriction bliterated, and, by a series of ugly tosses head, kept it swinging from side to side. ing the ten days that followed, about

FIG. 3.

thousand seals were killed and hauled l by the crew of the Proteus; and I had opportunities for observing their actions upon the ice and in the water. I there-tate, without fear of contradiction, that terly impossible for the animal to arrange ad-gear in the manner shown in fig. 2, that matter, in any figure that I have

largest males which I killed measured et in total length (from tip of nose to hind-flipper), and eight feet in girth. I that they do not attain their full growth en or twelve years of age. In the largest dual measured the uninflated proboscis led two hundred and twenty-five milli-s (nearly nine inches) in front of the lip. The height of the proboscis mid-etween the nostrils and tip was two hun-nd thirty millimetres; height at mouth, hundred and twenty millimetres. This s development is purely a sexual char-no trace of it existing in the female. It begins to appear in the third year, when, by passing the fingers into the nostrils, it may be detected as a small sac at the extreme end of the nose, divided longitudinally by the nasal

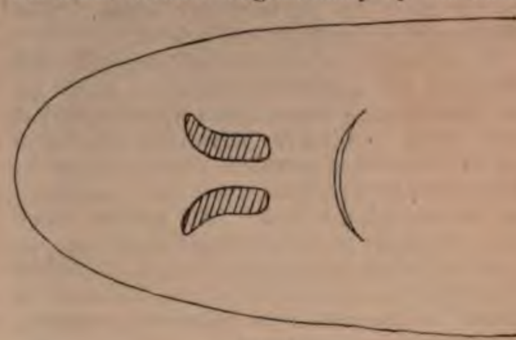


FIG. 4.

septum into two distinct chambers, which remain distinct throughout the animal's life. So far as I was able to ascertain from the examination of a very large number of individuals, it continues to grow for ten or twelve years.

Dissection of the proboscis, when in the adult condition, shows it to be a loose muscular bag, covered with the skin of the nose, and lined with a continuation of the nasal mucous membrane. It is completely divided for its entire length into two parallel chambers by a thin partition, which consists chiefly of two layers of mucous membrane, and is continuous with the nasal septum. The nostrils (fig. 4) are capable of closure by the contraction of muscular fibres, which are so arranged as to act as sphincters. To prevent interference in breathing by the falling together of the walls of this

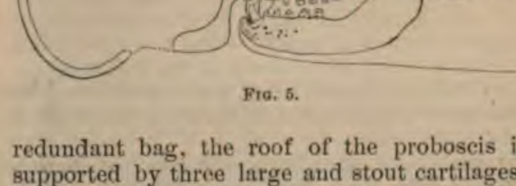


FIG. 5.

redundant bag, the roof of the proboscis is supported by three large and stout cartilages, —one median and two lateral (fig. 5). The median or septal cartilage, which is a continu-

ation of the mesethmoid, rises above the plane of the top of the skull, and extends forward beyond the jaw. A bilateral expansion of its base in front forms a firm supporting pad, resting upon the pre-maxillary bones. The two remaining cartilages are paired.

Since returning from the seal-fishery, I have examined the accessible works that would be likely to mention this curious appendage, but have failed to discover any thing approaching an accurate or complete description of it. That given by Fabricius more than a century ago is one of the best All writers whose accounts I have seen, including the most recent, agree in failing to express the chief characteristic of the animal, which is, that the so-called 'hood' of the male is an inflatable proboscis, protruding considerably beyond the mouth, which it overhangs.

C. HART MERRIAM, M.D.

MEASURING EARTHQUAKES.[1]

IN VIEW of the recent earthquake in England, and the still more recent shakings which parts of this country have experienced, a notice of the above work will be of especial interest. Professor Ewing's long residence in Japan as professor of mechanical engineering in the University of Tokio, and his active labors in connection with the Seismological society there, of which he was vice-president, entitle him to speak with authority on this subject. Indeed, in this matter of the exact measurement of the motion of the ground during an earthquake, seismologists the world over must look for enlightenment to young Japan, whose Seismological society, under the guidance of the foreign professors in her university and her college of engineering, has in this particular branch far outstripped European seismologists.

In chapter i. Professor Ewing gives a *résumé* of the theory of waves in an elastic solid, as applied by Hopkins, in the British association report for 1847, to the case of terrestrial disturbances; "since it both teaches the earthquake-observer what to look for, and guides him in the interpretation of his results." This shows how, from a single sudden disturbance, two series of waves will set out in all directions,— the first or normal waves consisting of compression and expansion of the material in the direction of transit; the second or transverse waves travelling more slowly, and consisting of motion of distortion at right angles to the line of transit,—also how these waves may be reflected or refracted at the bounding-surfaces between different strata, and thus by successive reflections be reduplicated; so that, at a distant point, the vibrations will probably be far different from (in number, order, phase, and period), and generally much more complicated than, those at the origin. Add to this the effect of imperfect elasticity, and the condition that the original disturbance may be a series of slips along a whole line or 'fault,' and nothing further could be desired to give confusion to the vibrations.

Chapters ii. and iii. deal with instruments for measuring the horizontal motion of the ground. At the outset Professor Ewing notes the difficulties in the way of getting a steady point, or something 'to tie to,' while every thing around is being shaken; and the characteristic feature of every seismometer is its method of supporting a heavy mass so that it will remain steady, receiving no impulse (save what is unavoidable through friction) while the system that supports it is being shaken. As the 'horizontal pendulum' seismograph in one of its forms is considered the best, and has given the greater part of the records obtained, its essential feature is here shown in fig. 1. Popularly it might be termed a heavy weight, swinging on a gate. It is a heavy mass, pivoted upon a vertical axis through *d*, upon a frame free to move about the vertical axis *bc*. The long light reed multiplies the motion, and records it upon a rotating smoked-glass plate by the steel pointer on its end. This reed is pivoted at *d*, with most of its weight taken up by the coil-spring, whose tension is adjustable at *e*. The parts of this supporting lever and long reed are so proportioned that in the vertical axis through *d* lies the centre of percussion relative to the axis *bc*: hence, if this is shaken through *bc* at right

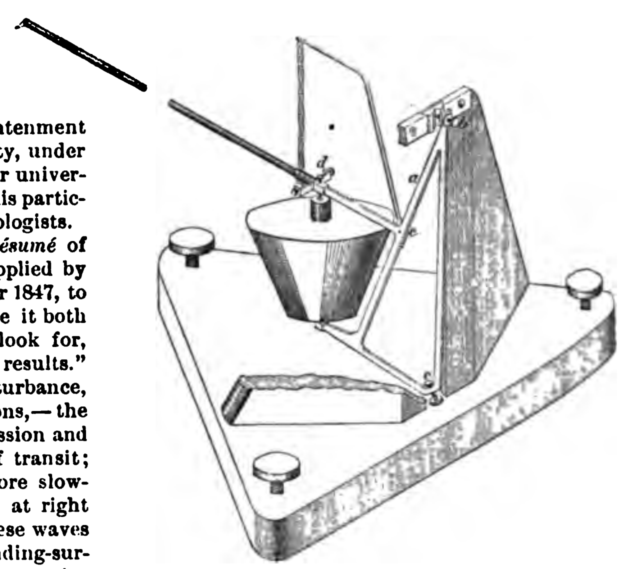


FIG. 1.

angles to the plane of the lever, the vertical through *d* will be of itself the axis of instantaneous rotation, independent of the heavy mass pivoted there; hence the latter will receive no impulse at right angles to

[1] *Memoirs of the science department, Tôkiô Daigaku (University of Tôkiô), No.* 9. *Earthquake measurement.* By J. A. EWING, B.Sc., F.R.S.E. Tôkiô, *Tôkiô Daigaku*, 1883. 12+92 p., 23 large plates. 4°.

lane of the lever, save that due to the very friction at *b* and *c* and at the marking-point; he purpose of the heavy mass is chiefly to fur- y its inertia, the necessary fulcrum upon which rcome this slight friction. These principles, as s centre of percussion, and axis of instantane- tation relative to the axis of support, are espe- insisted on by Professor Ewing as essential es of a reliable seismometer. Two of these ntal pendulums at right angles record the two

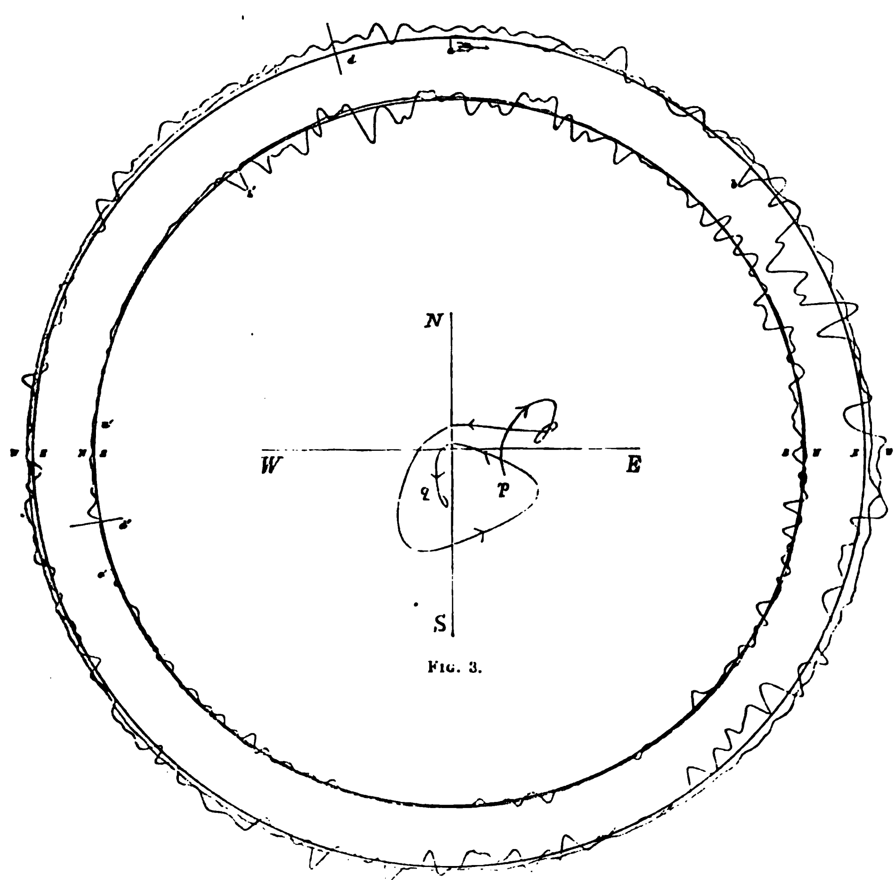


FIG. 3.

FIG. 2.

gular components of the horizontal motion rotating smoked-glass plate.

y other ingenious and novel forms of appara- registering the horizontal motion of the earth scribed in chapters ii. and iii., and various de- re described in chapter iv. for measuring the l component of the motion.

reproduce the trace of the earthquake of 1881, 8. Fortunately, Professor Ewing was present its occurrence, and, as it drew to a close, lifted rking-levers from the plate, so that their sub- t trace should not obliterate at all the record already obtained. Fig. 2 shows this record, made by a pair of horizontal pendulums multiplying the motion six times. As here reproduced, it is about twice the actual motion of the ground. The inner circle gives the N-S, and the outer the E-W components. At *d* and *d′* are two cross marks, showing where the pointers rested when the plate was stopped; and their angular distance is that to be used in connecting the two circles to obtain the simultaneous motion of the two points. The motion began on the outer, E-W, circle at *a* (corresponding to *a′* on the inner), and thence can be easily traced nearly twice round the circle to *c*, where the pointer was lifted (corresponding to *c′* on the inner circle). There was no appreciable motion in a N-S direction till about ten seconds after it began at *a*, E-W; but it began quite suddenly just before *b′*, and can be traced twice round to where the plate stopped at *d′*. The rotation time was about eighty seconds, and the earthquake had lasted about two minutes and a half when the plate was stopped. Feeble movements were observed some time longer.

In fig. 3, Professor Ewing has carefully combined the motion of the two components so as to give the actual path of a point of the earth's surface for a short interval. From p to q, following the arrow-heads, it shows that motion (magnified six times) during an interval of three seconds.

This same characteristic wriggling motion is shown in fig. 4, which is the entire record, magnified three and a half times, upon a stationary plate, of an earthquake which occurred on April 23, 1883, and lasted four minutes and a half. It is quite likely that the earthquakes which recently shook up our middle and western states would have given a somewhat similar record.

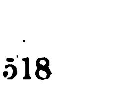


FIG. 4.

The principal characteristics of the average earthquake in the plain of Tokio are: 1°. The motion of the ground begins very gradually. 2°. An earthquake consists of many successive movements, and there is almost always no single large one which stands out prominently from the rest. 3°. The disturbance ends even more gradually than it begins. 4°. The range, the period, and the direction of movement, are exceedingly and irregularly variable during any one earthquake. 5°. The duration of disturbance of the ground is rarely less than one minute, and often several minutes. 6°. Even in somewhat destructive earthquakes, the greatest displacement of a point on the surface of the soil is only a few millimetres. 7°. The vertical motion is generally much less than the horizontal. 8°. A mass shaken back and forth in the most severe earthquakes of Tokio, would, if it did not slide, be urged by a horizontal force, which, at its maximum, would equal about one thirty-third of its weight. This, regularly repeated, is sufficient to crack brick walls, and sometimes throw down chimneys.

To the many readers who have had no experience of earthquakes, but are accustomed to think of them as a sudden violent thrust, accomplishing at a blow, as it were, all their disastrous work, the preceding descriptions will be a somewhat new revelation.

Professor Ewing plainly shows that as seismometers, the instruments in use by Palmieri and others are worthless; for not one of them can be depended upon to give a reliable measure of the direction, period, or amplitude of the vibrations of the ground, most of them being designed to record a single violent thrust in one direction, and nothing subsequent, and the greater part of them being some form of stable pendulum which is almost certain to be set swinging in an earthquake through amplitudes far greater than the earth itself, and thus to mask entirely the motion of the latter.

One novel 'time-taker,' the invention of Professor Milne, whose work in Japan is so well known, is
...ngs betw... ...ote. A clock has its hour, minute, and
worthy of n... all on the centre of the face, and of
seconds hands with their ends turned up into the
different lengths, ...pped with cork smeared with print-
same plane, and t... is a track upon which, when a
er's ink. In fron... circuit, a carriage travels up and
seismoscope closes a

presents a disk to the face, and then backs off again, carrying an impression of the instantaneous position of the three hands, and leaving the clock to go on undisturbed.

The closing chapter treats of the constructive details and requirements of a seismological observatory; and a series of experiments by Professors Milne and Gray are noticed, in which it was sought to determine, by a series of artificial earthquakes (dropping heavy weights in a foundery, and exploding buried cartridges of dynamite) in connection with time-recording seismometers, the velocity of transmission through the ground. These gave 438 feet per second for normal, and 357 feet per second for transverse, waves. This was through hardened mud. Mallet's earlier experiments gave for sand 825 feet, for jointed granite 1,306 feet, and for solid granite 1,665 feet, per second. The last, Professor Ewing remarks, is probably very much too low.

This element of earthquake motion, the velocity of transmission through the earth's crust, is very inexactly known; and the author notes the desirability of extending the observation of earthquakes over a considerable region of such a country as Japan by means of many stations connected by telegraph, to which simultaneous time-signals can be sent, and at which the same earthquake may be recorded on rotating plates, together with a record of the absolute time. These, if sufficiently widely distributed and numerous enough, would give us valuable data regarding the latitude, longitude, depth, and time of the origin of the disturbance, and the velocity of its transmission to the surface in all directions, supposing it rectilinear and uniform. Regarding the possibility of this, Professor Ewing, in the article referred to above (*Nature*, June 19, 1884), speaks as follows: "But all this depends upon our being able to recognize at the various stations, some one wave out of the complex records deposited at each; and, especially in view of the curvilinear nature of the motion, it would be hazardous to say, without trial, whether this can be done."

In conclusion it may be said, that the whole work is exceedingly interesting and valuable; and Professor Ewing is to be highly commended for thus bringing together the best results of modern methods in exact seismometry, and for showing the sources of error and the fallacies in older methods and theories. The work should receive as wide a distribution as possible by the University of Tokio.

H. M. PAUL.

EXCURSION MAP OF THE VICINITY OF BALTIMORE.

THE need has long been felt, among those students of the Johns Hopkins university who are especially interested in the study of natural history, of a reliable map of the adjoining country, on a suitable scale, and so mounted as to be adapted for convenient pocket use. It is believed that a few words regarding the method by which the want of it has been recently

in Baltimore, will have more than a merely erest.

students and instructors of the university ork naturally inclines them to out-of-door ions are associated in what is known as the ists' field-club; and it was decided by the s of this club, that a map on a scale of a the inch, covering an area twenty-five miles with the city-hall of Baltimore as its central would amply supply all present needs. The ies in the way of the construction of such a re, however, considerable. The cartographic ls already existing were very fragmental, and nuch in their form, scale, and reliability, while at cost of a new survey of so large an area t of the question. Mr. Albert L. Webster, r, who had had four years' experience as topog- on the U. S. geological survey, submitted a the trustees of the university, which met eir hearty approval.

naps, of whatsoever kind, relating to the area stion, were collected and carefully compared, st accurate of them being reduced to a uniform A drawing on the scale of two inches to a vas then commenced, upon which, however, e most reliable material — the work of the oast-survey, which covered about one-third of ire area — was incorporated. The remainder drawing was left blank, with the intention of upon it in future only such material as is up standard of the coast-survey work. For the ing two-thirds of the area a tracing was made he best existing sources, and the two together ng and tracing) reduced one-half, and photo- aphed. The present published map, therefore, scale of one mile to an inch, and represents st existing information relating to the vicinity timore. It is, however, not in any way to be ed as complete or final, but only as the first oward the attainment of a really good repre- ion of the region. It is doubtless faulty in particulars, and is certainly very deficient in g no topography. With a view to its improve- any suggestions relating to either details or the l character of the map, as well as any infor- regarding accurately determined elevations the area, are earnestly solicited from all per- who may make use of it. In this way it is that the map may be a constant growth, im- g year by year through the criticism and sug- s of those interested in it.

r the original drawing has once been made, the embodying improvements and publishing suc- editions is not large, and may easily be de- by the sale, at a moderate price, of the printed . The Baltimore maps, cut into sections and ted on linen, folding into a pocket-case, are sold ollar each.

se details are given in the hope of eliciting stions, or of inciting similar clubs, in other cities a good map is as much needed as in Baltimore, rt the development of something of the same

THE NEW-YORK AGRICULTURAL STATION.

Second annual report of the board of control of the New-York agricultural experiment-station for the year 1883, with the reports of the director and officers. Albany, *Weed, Parsons, & Co., pr.*, 1884. 279 p. 8°.

In the space at our command it is impossible to make any adequate review of the large amount of valuable work which we find in the New-York report. In general it may be said that it partakes of the characters of both the classes of experiments spoken of in our comments on p. 509. Some of it lies on the border-land between the two, yielding results of more or less immediate value to both science and practice. We include here such experiments as those upon methods of cutting seed-potatoes; the influence of depth, and distance apart, of planting, upon the crop; the effects of mulching, cultivation, root-pruning, and the like. Others are more distinctively scientific in their aim, such as the lysimeter observations, the notes on hybridization in maize, the experiments upon the influence of food upon milk and butter production, etc.

Perhaps the most noteworthy portion of the report is its proposed method of classification of artificial varieties of plants for purposes of identification. This method is based on the belief, confirmed by two years' observations, that those portions of the plant for whose sake it is especially cultivated are comparatively constant in form within the same variety, under the circumstances of cultivation, while the agriculturally unimportant parts may show considerable variations. For example: the roots of any particular variety of beet will show comparatively little variation, while the tops may present very considerable differences. Artificial selection has here impressed certain desired qualities upon the root, but paid little or no attention to the tops.

Proceeding upon this belief, it is proposed to base the classification in 'agricultural botany' upon the agriculturally important part of the plant. Thus all root-crops would be united into one class, irrespective of their ordinary botanical relationships, this class to be subdivided into smaller groups in accordance with the form of the root.

Such a method of classification for a particular purpose would appear to be legitimate. Its final justification is to be sought in its success, and of this it is too early to judge. When the observations shall have been extended over a term of years, and the constancy

of varieties established, agricultural botany may prove of much value to the farmer, gardener, and seedsman. Until then it belongs in the category of hopeful experiments.

MINOR BOOK NOTICES.

A treatise on the adjustment of observations, with applications to geodetic work and other measures of precision. By T. W. WRIGHT, B.A., late assistant engineer U. S. lake-survey. New York, *Van Nostrand*, 1884. 437 p. 8°.

THE student of the method of least squares often fails to grasp the true meaning and significance of the method, from the want of illustration and well-chosen applications. The chief merit of Mr. Wright's book is in the collection of examples which have been drawn from the records of actual work in which the author has been engaged. Besides the application of the methods of least squares to the results of triangulation and of levelling, a chapter is devoted to these methods in relation to line-measures in general, and to the calibration of thermometers.

There are some observers who are tempted to believe in the infallibility of certain criteria proposed by different writers for the determination of the weight of observations. There are others who reject the mathematical criteria, and prefer graphical methods as guides to a correct judgment. Mr. Wright is one of those who prefer to look at observations from the practical observer's point of view. His treatise will therefore be of interest to the mathematician who desires to frame criteria which will represent more closely the results of experience, and will prove of great utility to the practical man.

Recent progress in dynamo-electric machines, being a supplement to dynamo-electric machinery. By Prof. SYLVANUS P. THOMPSON. New York, *Van Nostrand*, 1884. (Van Nostrand sc. ser., No. 75.) 113 p., illustr. 24°.

THE writers who rapidly assimilate the advances in electrical engineering, and present their knowledge to the public in an intelligible way, are doing very useful work. The treatises of Professor Thompson are increasing upon the electrician's book-shelf. The time has not arrived for a standard treatise on electrical engineering, on account of the rapid changes and development of the subject. Until we can have such a standard treatise, we must rely upon brochures like this latest production of Professor Thompson.

The reader will find in it an account of Mr. Hopkinson's modification of the Edison dynamo, and also a description of the latest modifications of the Gülcher machine, and also of the Thomson-Ferranti machine.

Wonders and curiosities of the railway; or, Stories of the locomotive in every land. By WILLIAM SLOANE KENNEDY. Chicago, *Griggs*, 1884. 16+254 p. 12°.

ONE is a little startled, on opening this book, to find mentioned the "huge, ample-shadowed foundry; the peculiar fragrance of burnt earth and iron; . . . the boy controlling the huge steam-hammer; . . . and, finally, the great crane that lifts up the monster in chains, and carries it to the doorway, and sets it down in all the resplendence of its polish and paint, ready to begin its thirty years of toil," with nothing predicated of them; but is relieved immediately by the statement that 'this is the building of the locomotive.' This introductory chapter, in which 'our old Homeric poet Whitman' receives praise, and which may have been written by him, should not, however, deter the reader from going deeper into the book. From chapter ii. on, the writer tells the anecdotes he has collected in regard to the railway, and has succeeded in bringing together a most entertaining collection. The account given of the Quincy railway must change the impression that many have of that so-called 'first American railroad.' The chapter on the 'locomotive in slippers' is devoted to the history of the railway in the east, and at times is especially amusing. The author also touches upon the 'vertical railway' (the elevator), upon the various mountain railways, and upon the recent attempts to use electricity as a transmitter of power.

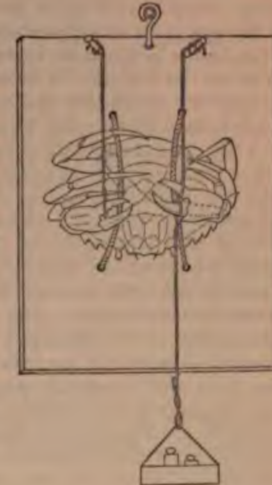
NOTES AND NEWS.

A CONFERENCE to formulate plans for the systematic observation and discussion of earthquakes was recently held in the rooms of the U. S. geological survey in Washington, at which there were present Messrs. Powell, Dutton, and Gilbert, of the survey, Abbé and Marvin of the signal-service, Paul of the naval observatory, Rockwood of Princeton, and Davis of Harvard college. It was decided that three classes of observations should be attempted; the first class consisting of those made by self-registering seismometers of approved pattern, upon which Messrs. Paul, Rockwood, and Marvin are to report at an early date. The second-class observations will be chiefly to determine the time of shock, probably by means of a

raph of relatively moderate cost. The third ll include ordinary non-instrumental observa-ecording to a system to be prepared by Pro-Rockwood. It is expected that a considerable of the first and second class instruments will tained by co-operation of public institutions vernment bureaus, at observatories, physical ories, army arsenals and signal-service sta-nd navy-yards; while the instructions for the observations will be sent to all the regular lunteer observers of the signal-service, the rs of the state weather services, and to all who desire to aid in the work. In order to rate work on the most profitable districts, a f recorded shocks will be prepared by Professor od; and the selection of stations will then be ed by Messrs. Rockwood, Abbe, and Davis. r studies will be undertaken on the matters ography, previous observations, and instru-the whole work being under the direction of logical survey.

e recent works of the U.S. geological survey, pecially the remarkable report of Capt. Dut-ve given an opportunity to Professor Traut-of Moscow to draw a parallel between the cal structure of Colorado and that of European which appears in the bulletin of the Moscow of naturalists. In Russia the Silurian, an, carboniferous limestone, and lower Per-eries are marine deposits, while the upper n is of fresh-water or terrestrial origin. The d lower Jurassic rocks are also continental s, or seem to be so to a great extent, while er Jurassic groups are again of marine origin, so the chalk, which contains only islands with getation. Three parts of the tertiary series of terrestrial and fresh-water deposits, marine appearing only in the south; and the qua-is also a continental formation. Such being, ng to Professor Trautschold, the structure of he had already concluded that in the north-misphere there was a general retreat of the ing paleozoic times, and a growth of conti-upon which the carboniferous and then the n floras largely increased; European Russia during the triassic and the first half of the c periods, a continent with nearly the same s as now. During the second half of the c period, another subsidence of the continent, advance by it into the northern hemisphere, took place; without reaching, however, the level that it had had during the paleozoic the sea remaining shallow. A second retreat water took place during the tertiary and ary periods. Similar oscillations might well , in Professor Trautschold's opinion, the re of the Grand Cañon district, where the tion between the Jurassic and triassic is as s in Russia.

om recent experiments to determine the abso-rce of the flexor muscles of decapod crusta-Professor Felix Plateau of Gand, Belgium, les that the absolute or static force of the muscles of the claws of crabs is relatively weak, and that while the adductor muscles of some lamelli-branchs are comparable with those of mammals, and others with the more powerful muscles of the frog, the muscles of the claws of crustaceans can be com-pared only with the weakest muscles of the frog. The relation between the absolute force of the muscles of man and the greatest pow-er Plateau had ob-served in the crusta-ceans, convinced him that the contractile force of the muscular fibre is not the same in all animals. Ar-thropods are inferior in this respect to mammals and to la-mellibranchs. Crus-taceans, like insects, have in proportion to their weight much greater power than the vertebrates. When experimented on, as in the figure given, he found that common crabs could raise from one to two and a half kilograms, representing a force which he thought clearly explained the mishaps undergone by these animals.



— The women medical students of Paris have pre-sented a petition to the authorities for permission to walk the hospitals, and become house-surgeons there-in. The petition is supported by a considerable num-ber of physicians and surgeons.

— The ship Occidental, at San Francisco, Nov. 14, reports, "At six P.M., Nov. 4, a hundred and fifty miles off Mendocino, Cal., had three shocks of earth-quake, and a few hours later two more heavy ones."

— Mr. E. Knipping, meteorologist of the Imperial meteorological observatory at Tokio, describes in the September number of the *Mittheilungen der deutschen gesellschaft für natur- und völkerkunde Ostasiens*, the rapid development of weather telegraphy in Japan. There are now twenty-four stations in the empire connected by telegraph; and on the basis of their observations, supplemented by despatches from China, three daily synoptical maps are published in Japanese and English characters. Observations are taken at six A.M., and two and nine P.M., 'Japan' time, which is about that of the Kioto meridian; so that the even-ing observation corresponds to eight o'clock 'China coast' time, six o'clock 'Bengal' time, four o'clock 'Persian' time, one o'clock 'German' time, and noon in 'English' (Greenwich) time. The director of the service is Mr. I. Arai; and the observers, telegraphers, draughtsmen, and printers are all Japanese. The first weather-map was printed on March 1, 1883, and the tri-daily issue began a month later. The chief

need of the service at present is the addition of the fifty-six lighthouses to the other stations, and the construction of a submarine cable to the Liukiu (Loo Choo) Islands.

— The first part of the Atlas of the western-middle anthracite coal-field has lately been issued by the Second geological survey of Pennsylvania, the work being in charge of Mr. C. A. Ashburner. It comprises the district between Ashland and Mahanoy City, and is in the same style of construction as the atlas of the Panther-creek basin, of which mention has already been made in *Science* (i. 309). The new maps fully maintain the high standard of accuracy, and the careful distinction between observation and inference that characterized the earlier number of this important contribution to practical geology. The atlas includes four mine-sheets (1:9,600, with underground fifty-foot contours of mammoth coal-bed), three topographical sheets (1:19,200, with surface form in ten-foot contours), and four cross-section sheets (scale, 1:4,800). The reference-lines, marking out squares of two thousand feet on a side, are now properly adjusted to the true meridian, instead of to the local and temporary magnetic north, as before; and the ground-colors representing the geological subdivisions are changed to tints of rather more agreeable tone. The full indication of the known facts on the basis of which the area and altitude of the coal-beds are represented, and their careful separation from hypothetical lines of outcrop and dip, make it possible for both the practical and the theoretical geologist to use these sheets with as little effect as possible from the personal equations of those who made the maps. Besides being issued, folded in the octavo atlas, the sheets can be bought, unfolded and singly, at simple cost of printing, — about fifteen cents apiece.

— In a recent lecture upon the languages of the American aborigines before the Lowell institute in Boston, Prof. D. G. Brinton endeavored to show the general characteristics of the American languages to be *synthesis*, or the blending of a number of words into one; *incorporation*, or the absorption by the verb of both subject and object: and the peculiar use of pronouns. Other features were described and illustrated, such as the absence of grammatical gender and of the true substantive verb, the rarity of numerals and of the true adjective, and the difference in the speech of the two sexes and of different ages and classes. In spite, however, of the absence of all etymology, these languages are very interesting. While they lack in parts of speech, they are rich in themes and ideas. They were shown to compare favorably with European languages in respect to their vocabularies and their ability to express abstract ideas, but to be deficient in respect to sentence-building. The lecturer claimed, however, that the importance of any language depended upon the use that was made of it. After showing that unwritten language is not necessarily liable to the greatest changes and fluctuations, and that language forms a satisfactory basis for studying the laws of ethnology, the characteristic features of the principal aboriginal tribes of North America were briefly sketched, and the peculiarities of their language described. The Narwatal language of Mexico was asserted to be the only aboriginal American language for which a regular professorship had been established in any university. The literature which survives, of the native languages of Mexico and Central America, was described. The lecturer closed by urging those who wished to study the American languages to do so at once, as the time was not far distant when these languages would have entirely disappeared.

— Professor Liversidge of the Sydney university, says *Nature*, sends to the local press a suggestive communication, in connection with the recent meeting of the British association in Montreal and the invitation forwarded by the Victorian premier to visit Melbourne next year. Feeling how insurmountable, for the present, are the obstacles to such a visit, the writer proposes what appears to be a very wise alternative. Instead of looking forward to a near visit from the association, he suggests as a preliminary step a federation of the various scientific societies in Australia, Tasmania, and New Zealand, into an Australasian association for the advancement of science, on the lines of the British association. A first meeting of the new association might be held in Sydney on the hundredth anniversary of the colony; which, with the combined attractions of an international exhibition, might induce a fair number of scientific visitors from England to take part in the proceedings. After the first meeting, gatherings could take place annually, or every two or three years, as might be agreed upon by the members, in various parts of Australasia. The writer concludes with the remark, which few will gainsay, that such an association would tend greatly to advance the sciences in the colonies, and in many ways materially favor their progress elsewhere.

— Dr. Kollmann announces a law of correlation governing the form of the face of European man. Two modern Swiss skulls from the collection at Basle, which may be duplicated in any collection of European crania, represent two types existing in the present population of Europe, — the broad-faced (chamaeprosope of the craniologist), and the narrow-faced (leptoprosope of craniology). The broad-faced variety is wide between the eyes, with broad low orbits, short nose with low bridge, wide nostrils, and broad mouth. The narrow-faced variety has slender features, round open orbits with eyes set near together, long nose with high bridge, narrow nostrils, and small mouth. Either variety, if pure, will present its characteristic features, while, if crossed, the degree of mixture may be determined by the number of features varying, and the amount of variation from the general type.

— Professor Haynes requests us to state that the closing sentence of his letter on p. 469 should read, —

"There is no doubt whatsoever that it is the relics of men very like those first found by Europeans on this continent, which Mr. Jacob Messikommer will help any one, as he did the writer, to disinter from the peat-moor of Robenhausen."

SCIENCE.

FRIDAY, DECEMBER 12, 1884.

COMMENT AND CRITICISM.

QUESTION of manual training is begin-o receive in this country the attention erves. Among the indications of this re point to the experiments which are gress in New York, Philadelphia, St. Chicago, Baltimore, and other impor-ties; to the admirable debate (never, lieve, adequately reported) which oc-in the section of mechanics at the elphia meeting of the American associa-to the report presented to congress a r more ago on technical education, by Eaton, the U. S. commissioner; to the t which has been awakened by the Brit-mmission report on the same subject, ch three volumes have appeared; and, to the action of the Slater trustees in ig that the income which they distribute the schools for freedmen shall only be to schools where manual labor or handi-encouraged.

e light is thrown upon principles and s by a recent paper on technical educa-y David Sandeman and E. M. Dixon sgow. They discuss the relations of mentary school and the work-shop; , the part which secondary schools may preparing boys for industrial pursuits; he sphere of school work-shops or tech-chools. Their conclusions, which are eral interest, though intended only for d, are briefly stated, as follows: Every ould have as good a general education an get; as circumstances differ, schools e adapted to different wants of the ial classes; there should be elementary for children less than thirteen years condary schools for more who can con-study until they are sixteen; and, in both, school work-shops should be established; apprenticeships might thus be reduced in time; finally, trades should be taught systematically to the young, after they leave school, either in a work-shop or in a special building detached from a work-shop, as experience may suggest.

AN ARGUMENT which did good duty during the dark ages, but which has fallen into disuse in later times, has seldom been more *naïvely* employed than in the following passage, taken from a little book just published, 'On the discovery of the periodic law:' —

"Are the atomic weights invariable? This question must most probably be answered in the affirmative. If the atomic weight of an element varies, such variation is most likely very slight, otherwise the simple relation between the atomic weights of the elements when arranged in their natural order would be liable to be disturbed."

Mr. Newlands (late professor of chemistry in the City of London college), who is the author of the above passage, is also a claimant to the honor of having discovered Mendelejew's periodic law. How far chemists were from suspecting the truth of that law in 1866, appears from the fact, that, at a meeting of the Chemical society, Prof. G. F. Foster humorously inquired of Mr. Newlands whether he had ever examined the elements according to the order of their initial letters.

HOW MUCH brighter is sun than moon? Can anybody tell? Has anybody tried to tell? What shall be the standard of measurement? Sir William Thomson has lately printed a note which conveys some curious data bearing on these questions. During the meeting of the British association at York in 1881, he observed the moon when it was nearly full, and at about midnight. He found the light to be equal to that of a candle at a distance of two hundred and thirty centimetres. Making no account of the loss of moonlight in transmis-

sion through the earth's atmosphere, he computed that twenty-seven thousand million million candles must be spread over the moon's earthward hemisphere, painted black, to send us as much light as we receive from her. Probably forty thousand million million candles would be required to allow for absorption. Sir William carried his computations a little farther, and figured, that, if the face of the moon which we see were painted black, and covered with candles standing packed in square order, touching one another, all burning normally, the light received at the earth would be about the same in quantity (as estimated by our eyes) as it really is.

How does moonlight compare with sunlight? On the 8th of December, 1882, Sir William Thomson in Glasgow measured the brilliancy of the sunlight at one P.M., and computed that it was about fifty-three thousand times greater than that of a candle-flame. This, he says, is more than three times the value found by Arago for the intensity of the sun's light. 'So much for a Glasgow December sun!' Hence he derived the conclusions that the Glasgow sunlight was seventy-one thousand times the York moonlight, and that "we cannot be *very far* wrong in estimating the light of full moon as about a seventy-thousandth of the sunlight anywhere on the earth." Those who are curious to know more of this inquiry will find the note to which we call attention in the proceedings of the Glasgow philosophical society for 1882–83.

LETTERS TO THE EDITOR.

*** *Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The oldest living type of vertebrates.

I was gratified to have my own conclusions as to the systematic relations of the galeoid Selachians verified by so competent an original investigator as Mr. Garman. The differences between us now are fictitious rather than real; or better, perhaps, they are chiefly differences of expression.

As to the characters of the Opisthartliri, it must be remembered that I assigned them long before Chlamydoselachus was known; and then the statement that among living sharks they 'alone exhibit' the 'peculiarities' specified, was literally true.

'The palato-quadrate, not articulated with the skull,' is a true character of the typical sharks and Rhinae. Of course the apparatus, being the suspensorium of the lower jaw, must have *some* connection with the cranium; but it is indirect, and not direct. The name 'Anarthri' is therefore quite appropriate, contrasting well with 'Opistharthri' and 'Proarthri.' The newly proposed term, 'Mesarthri,' is, however, unobjectionable, although I should still, independent of priority, prefer Anarthri. No one who took an intelligent interest in the subjects in question would be misled by the name 'Anarthri,' or the diagnoses of the Anarthri and Rhinae.

I must dissent from the opinion that the Cladodontidae are related to the Chlamydoselachidae rather than to the Hybodontidae. To traverse the question would, however, infringe too much on your space.

Mr. Garman, in his substitute for my provisional diagnosis of the Selachophichthyoidei, 'vertebral condition unknown,' has added to our knowledge of the group by verifying my suggestion (*Science*, April 11, 1884) that the "anatomy will probably reveal a structure most like that of the Opistharthri."

I am pleased to find that the views of Mr. Garman as to the remoteness of the Xenacanthini or Ichthyolomi from the true selachians agree with those expressed by myself. The Xenacanthini, in fact, appear to me to be true fishes rather than selachians, although not teleosts, as has lately been urged.

THEO. GILL.

Hornblende andesite from the new Bogosloff volcano.

A short time since, there were received at the National museum, from Lieut. George M. Stoney of the Ounalaska, several fragments of rock from the new volcano on Bogosloff Island in Bering Sea. On account of the interest just now attached to this locality, it is thought a brief notice of these may not be out of place here.

The rocks are hornblende andesites. Two varieties were received, — one very light gray and slightly purplish in color, fine-grained, friable, and somewhat porous; the other dark gray in color, and much more firm and compact in texture; both varieties containing macroscopic hornblende and plagioclase, and, under the microscope, seen to be nearly identical, each consisting of a gray groundmass in which are embedded deep reddish-brown, strongly dichroic hornblendes, light green augites, and numerous crystals of a plagioclase felspar. Sanidin is also present, a very little apatite, and the usual sprinkling of iron oxides, which seem to be largely magnetite. The groundmass consists of a microfelsitic base, carrying colorless microlites, grains of opacite, and minute yellowish and greenish particles which are probably hornblende and augite. The light-colored variety contains small patches of a nearly colorless glass, while the dark variety seems felsitic throughout. A more detailed description of these rocks will be given later.

GEO. P. MERRILL.

National museum, Washington,
Dec. 1.

Edison's three-wire system of distribution.

Referring to the article with the above heading in No. 94 of *Science* (Nov. 21), it is not difficult to show that the conclusions reached are not in harmony with the fundamental proposition governing the size of electric conductors. This proposition is, that "the additional running-expense due to the resistance of the conductor shall equal the interest on

cost." The correctness of the principle has stablished by Sir William Thomson and oth-

e three-wire system, Edison reduces the cur- one-half its value in the two-wire system, reases the total resistance of the same number ps to four times the former value, by the ar- nent shown in the second diagram of the arti- rred to. The total heat-energy developed in nps, then, remains the same, since it is rep- d by C^2r, where r is the combined resistance lamps in multiple arc. The inference is, that sistance of the leading wires should also be sed fourfold. In the articles referred to at the of the page; it is shown that the cross-section conductor should vary simply as the current th. Hence the conductors in Edison's three- ystem should be diminished only one-half in r greatest economy of working. That this is y correct will appear from an examination of ergy expended in heating the leading wires in eral cases. In the two-wire system

$$C = \frac{E}{R + r}, \tag{1}$$

ich R and r are the resistance of conductors mps respectively. In the three-wire system as ed by Edison

$$\tfrac{1}{2}C = \frac{2E}{4R + 4r}. \tag{2}$$

three-wire system, with conductors half size,

$$\tfrac{1}{2}C = \frac{2E'}{2R + 4r'}, \tag{3}$$

ch E' equals the electromotive force of each of o dynamos in series. This electromotive force lower than in cases one and two. From (1), $R + Cr$, and $EC = C^2R + C^2r$, for total elec- nergy expended; the first term being the heat- in the conductors, and the second the energy ded in the lamps.

n (2), $E = CR + Cr$, as before. The total en- $\tfrac{1}{2}C \,.\, 2E = CE$, the same as before. From (3), $CR + Cr$, and the total electrical energy is $E' = CE' = \tfrac{1}{2}C^2R + C^2r$. The energy expend- on the lamps is the same in the three cases, represented by C^2r; but in the third case the aste is $\tfrac{1}{2}C^2R$, or only one-half as much as in her cases. In Edison's arrangement the ratio en energy expended in the lamps, and heat- in the mains, is the same in his three-wire as in the two-wire system. If the conductors luced to only half their former cross-section, tio of heat expended in conductors to heat ped in lamps is only half as great as before. saves 62.5% of the cost of conductors, or 62.5% interest on their cost, the running-expenses ning the same. With half-size conductors, the would be 25% in interest on cost of conductors, % in heat-waste on conductors, or a total of 75%, in of 12.5% over the plan adopted by Edison. ver, the electromotive force of each machine lower, the dynamos could be reduced in size, eir cost would be less. In reducing the con- s three-fourths in cross-section, the rise of rature for the same quantity of heat developed m is four times as great as in the two-wire sys- nce their capacity for heat is reduced to one- . In the case of conductors reduced one-half , the rise of temperature would be the same as with the two-wire plan, since the energy expended in heating them is one-half, and their thermal capacity is also one-half. We have supposed, in the calculated economy, that the three wires are all of the same size. Their combined cross-section would then be $\frac{3}{2} \,.\, \frac{1}{2} = \frac{3}{4}$ of the combined cross-section of the two wires in the first plan. The saving in interest on conductors would then be 25%. Edison sacrifices running-expenses in order to diminish the size of his conductors beyond what is clearly the most economical arrangement. We take it for granted that the principle of making loss by heat-waste in conductors equal to interest on their first cost was taken into account in calculating the size of conductors in the two-wire plan.

H. S. CARHART.

Evanston, Ill., Dec. 1.

ture, vol. xxiv. p. 480; *American engineer*, Nov. 7, 1884.

CAN GHOSTS BE INVESTIGATED?

IN the last number of *Science*, Mr. Gurney, honorary secretary of the Society for psychical research, replies to my paper in *Science* of Oct. 17, 1884. To one whose experience has been that scientific discussion is often nugatory because the parties sedulously refuse to understand each other, it is a great pleasure to read Mr. Gurney's paper. The reader who compares it with my own, will, I think, have a fair view of the two sides of the question from the special point of view which we have heretofore taken. I therefore ask permission to consider the subject from a somewhat different standpoint.

When one adduces evidence in favor of telepathy between living persons, each having the other in mind, I am prepared to listen in the spirit of one who feels that there may be many things on earth not yet dreamed of in our philosophy. But when an imposing array of evidence is presented, tending to show telepathy between a live man and a dead one, I must frankly confess that I cannot help receiving it in the spirit of the African monarch of whom the following story is told. He had captured a Dutchman who had been trespassing on his territory, and was about to put him to death. The prisoner, however, like the heroine of the 'Arabian nights,' managed to postpone the fatal day from time to time by inventing stories about the wonders of civilization with which to regale the royal mind. When his inventive powers had reached their limit, he felt obliged to fall back upon facts,

and so told the king that the water in the lakes and rivers of his native country annually became so hard that people walked and drove upon it. The king, in a fit of rage, informed the Dutchman that he not only did not believe this story, but now he did not believe any thing he had been telling him, and ordered him to immediate execution. The reader can point the moral.

Let us now inquire whether the ghost side of telepathy can possibly be established by the methods hitherto employed for that purpose. I will start out by trying to answer the question asked Mr. Gurney in the last number, respecting the probable number of respectable credible people in the British Islands who would not be above amusing themselves at the expense of a learned society. Without waiting for his reply, I roughly estimate that the number of respectable credible people alluded to exceeds fifteen million. Knowing what we do of human nature, I conceive that it will not be considered excessive to suppose that one out of every thousand would come into the category in question. This would give fifteen thousand people who would be capable of the pleasantry alluded to. It must be expected that some of them would forward replies to such requests for information as have been circulated in England. How are the reports of such people to be eliminated from the mass? It will be hard to establish even the possibility of detecting the frauds.

It may be asked in reply whether the conclusion thus intimated, if extended to other departments of inquiry, would not lead to a general lack of confidence between man and man, and to an unjustifiable incredulity in regard to human testimony in a very wide field. My reply is, that there are wide fields in which human testimony would be wholly unreliable, but that methods for eliminating the false, and preserving the true, have come into use. These methods are so common and familiar that we forget all about them. Let us suppose that a paleontological society should advertise for human skulls found in the tertiary deposits of a country. Suppose, also, that any ingenious person could in fifteen minutes manufacture a skull which the most diligent investigation of paleontologists could not distinguish from a genuine fossil. Can any one doubt that the society would be deluged with skulls? Could any investigator be made to believe in a single one of them? I trow not. The fact is, that the only security that paleontologists have from being imposed upon by manufactured specimens lies in their power of distinguishing at a glance the true from the false. When, as in a case known to the writer, a man who has spent several months in elaborating a row of fossil bird-tracks brings his production to a museum, and is informed on sight by the professor in charge that this specimen is very interesting, because he recognizes the tracks as those of the domestic turkey, it produces a depressing effect upon all manufactures of this class. When psychic zoography is so far developed that a spurious ghost can be distinguished from a real one with the readiness with which Cuvier is said to have detected a spurious devil, there will be some outlook for establishing the existence of such beings. For this stage the reasonably incredulous will be likely to wait.

I have spoken as though the question were that of intentional deception. In fact, however, it is hardly necessary to suppose any thing of the sort. It is only the fortunate few of mankind who are not subject to lapses of memory, and illusions respecting the time and place at which events have happened, as well as to illusions of the senses. So far is this true, that a prudent person will rarely trust implicitly to a presentation of any complicated statement made by another, unless it is verified by independent evidence. If two persons could see and describe the same psychic phenomenon, the case might be better; but, as it really stands, there is no way of eliminating delusions, deceptions, or mistakes of any kind.

There is, however, a conceivable method by which every thing except intentional deception may be avoided. Let any psychical society issue to the people of a country a request that any person impressed in an unusual manner,

er in his sleeping or waking hours, with pparent sight or presence of a person he knows, shall immediately, without g for further investigation, state that n a postal-card, and mail it to the society, careful to give the name of the person; at any remarkable connection between mpression and any other circumstance quently discovered shall be sent in an-communication. It should be distinctly stood that no case will be taken into ac-unless it is shown that the first card was l before the knowledge contained in the l was acquired. A correspondence of ort might lead to something worthy of y and investigation.

evidence of haunted houses is entirely nt in kind, but I must frankly admit that urney's reply to what I said on the sub-my previous paper does not strike me as ctory: indeed, he quite mistakes the point illustration, which was intended to show vents are all the time happening which unable to explain. The same logic that s would, it seems to me, lead to the con-n that all tricks of the juggler which we not explain after the most careful exami-must be due to some other than known l causes. The general rule which we all sciously apply is, that if, upon investi-a class of seemingly unaccountable phe-a, we readily explain one-half, then n another portion after much investiga-and with yet additional toil and industry d in explaining a third, but finally still an inexplicable residuum, we conclude his residuum could also be explained if ew all the circumstances. This is the sion which everybody adopts in the af-f common life; and I see no reason for g an exception to it in the case of that collection of haunted houses which the ttee on the subject has found it impossi-explain.

sum up, I deem it essential that psychic gators should find stronger evidence for probable than for the impossible.

SIMON NEWCOMB.

SOME IMPLEMENTS OF THE MINNE-SOTA OJIBWAS.

THE uses of a portion of the implements figured in Abbott's 'Ancient stone implements of eastern North America' are still somewhat open to conjecture. One group, comprising oval, grooved pebbles, has recently been reduced by Dr. Abbott to a classification comprehending mauls, club-heads, bone-breakers, and net-weights respectively (*Science*, iii. 701). These neolithic objects, and a second series closely allied to them, appearing in considerable numbers upon the New-Jersey coast, are attributed by their discoverer to the Indian races inhabiting the country when first colonized by Europeans; that is to say, to the Lenni Lenapé, or Delawares.

Now, the latter tribe, if it may still be called a tribe, is a cognate of our Algonkin-Ojibwas of the north-west. The languages of the two peoples are essentially the same, being dialects of the common Algonkin tongue, like the speech of the Canadian Crees, of the New-England Indians (preserved to us by the Eliot Bible), and of other nations. The Ojibwas, therefore, may not unreasonably be expected to retain, at the present time, vestiges of early race-ideas and race-practices which may, perhaps, serve in some way to illustrate the archeology of dead branches of the parent stock. Hence the writer of this paper thought it not amiss to set on foot inquiries touching the actual use of the two sets of implements instanced among the Ojibwas of Red Lake, northern Minnesota, where, owing to peculiar isolation, tribal peculiarities are believed to have been retained to an exceptional degree.

The members of the second series of implements, indicated above, are described as flat, discoidal pebbles, with side-notches, which in thickness vary little from about half an inch. These Dr. Abbott regards as almost certainly net-weights, considering that there would be no room for doubt upon the subject, were it an ascertained fact that the Delawares of prehistoric time were actually acquainted with the manufacture and management of nets. Now, the Ojibwas are credited by their native historian, Mr. William Warren, with making and using fishing-nets before the appearance of the whites in North America. In describing the Ojibwas seated upon the shores of Lake Superior, at La Pointe and vicinity, prior to the advent of the whites, he says:—

"The waters of the lake also afforded them fish of many kinds,—the trout, siskowit, white-fish, and sturgeon,—which in spawning-time would fill their

rivers, where, making racks across the stream, they would spear and hook up great quantities as the fish came down after spawning. They made nets of cedar and basswood bark, and from the sinews of animals. The ribs of the moose and buffalo made materials for their knives. A stone tied to the end of a stick, with which they broke sticks and branches, served the purpose of an ax. . . . Bows of wood, stone-headed arrows, and spear-heads made of bone, formed their implements of hunting and war."

Ojibwa gill-nets.—The nets used by the Red-Lakers are exclusively of the pattern known as gill-nets. When set, the apparatus depends like a perpendicular curtain from one of its longer margins, which is buoyed at the surface of the water by a succession of wooden floats (see fig. 1) tied to it at regular intervals

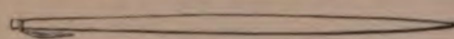


Fig. 1.—Net-float, 30½ inches long.

of a few feet with bits of grass, rush, bark, or of the material of which the nets are manufactured.

The net-appendages of stone are of two sorts. First, there are small manageable pebbles, or rough bits of rock, which, at intervals corresponding to those between the floats, are fastened along the under margin of the net, to hold it perpendicular in the water. These net-weights weigh a few ounces each, and are

Fig. 2.—Net-weights, one-half natural size.

never notched (see fig. 2). They are simply tied about the middle with the bit of grass, etc., by which they are hung to the net.

Second, there are heavier stone anchors weighing from three or four to six and eight pounds each, which are suspended from the lower corners of the net to prevent it from drifting out of position. Sometimes one of these is also hung midway between the others. The net-anchor is also a mere unwrought block of stone of convenient size and shape. To prepare it for use, it is wound about and knotted in repeatedly with long, strong strips of bark, which, perfectly serving the purpose of cordage, enclose it in a rude kind of tackle. A lighter or heavier set of anchors is attached to a net according to existing conditions of wind and wave. The necessary anchors, with their bark investitures, are conveyed to the fishing-grounds before being hung in place, while the net-weights proper are more permanent fixtures. Indeed, I have seen the floats and stone-weights put upon the net as the work of manufacturing it went on.

Gill-nets being designed to insnare by the gills, they are adapted in size to the particular species of prey to be captured. Thus a family often employs a set of nets of different meshes. For example: Mrs. Dick Big-Bird, a Red-Lake woman of a thrifty turn of mind, keeps in stock four nets, ranging in point of mesh from small to great, and of such a length, that, when they are extended to the utmost longitudinally, they have a measurement of eighteen arm-stretches,—an arm-stretch equalling the spread of the two arms.

Lost net-weights, tied up in their little grass fastenings, occur most abundantly where they have become detached in dragging the fishing-apparatus over the ground, and likewise in spots where the women are accustomed to mend their nets and to spread them for drying. Of course, great numbers of these objects are also lost in the water from being washed out of their lashings. If we allow to a single outfit a complement of from twenty to thirty weights, with a varying equipment of anchors, we find that prodigious quantities of these stone bits must be used at one time and another, at every considerable fishing-station. The weights described would not, it is true, be recognizable in the future as remains, since they are wholly unwrought; but it is easy to imagine conditions which would necessitate the notching of these fragments, and thus render them subject to identification

things being equal, it would seem that lisks of stone would naturally be chosen e purpose in question, as being least diffi- work notches in.

nay be proper to explain, that Red Lake the Ojibwa reservation of the same , to the north-west of the head waters of Iississippi River. The band of about e hundred Indians inhabiting the reser- originated at Lake Superior, and jour- hither by way of Rainy Lake; but it has nore or less re-enforced during its century stence by Ojibwas of identical extraction, g from various other northern lakes of ate, as Cass Lake, Gull Lake, and Win- shish and Leech Lakes. Hence it may erred that the mode of net-fishing here sed is one prevailing commonly among ke Ojibwas of the north-west; and this s substantially with their own state- upon the subject.

pping-stones. — It cannot be doubted, er, that notched discoidal pebbles have in use among the Ojibwas from time morial as fuel-breakers. The objects fig- in Abbott's 'Stone age in New Jersey' 204, 205), old edition (see fig. 3), are

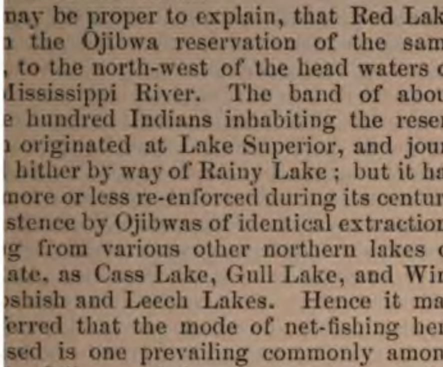


FIG. 3. — CHOPPING-STONE.

ed by the Red-Lakers to be precisely as are described by Mr. Warren in the tion given above. These little implements lled axes, though they are not designed tting, and might with more propriety be lized as chopping-stones. It goes with- ying, that the primitive Ojibwas did not themselves with fuel after our fashion. never cut body-wood for firing; but, hav- command the illimitable forest with its ance of fallen trees, they provided for h by simply breaking the dried bark and or large branches close at hand, into lengths suitable for their purpose. Indeed, families very generally changed their dwelling-place, during the season of greatest cold, in order to bring such supplies within easy reach.

The tools represented by these figures seem much too small for effective work in their line, but I was assured by the Indians that this is not the case. In fact, the summer fires kept up for the purpose of driving away insects, and for drying fish and other game, and corn, as well as for occasional cooking processes, are commonly maintained (many times by children) with mere twigs, and such small boughs as would be most easily separated by a chopping-stone of small size. Old Ojibwa authorities state that they know no Indians who do not avail themselves of these simple fuel-breakers whenever unprovided with better tools.

Rat-and-duck arrow. — The small object illustrated at fig. 4 is a weapon of the chase,

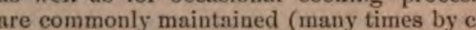


FIG. 4. — RAT-ARROW, NATURAL SIZE.

which is known to have been in occasional use at Red Lake as recently as a half-century ago. It was collected some years since by Mr. Elmer Hamilton, of the agency, from the beach of Red Lake, where it had been newly thrown up by the waves. A portion has been broken from the extremity of the stem, so that, as figured, it does not show the original length.

This instrument was unknown to the younger Ojibwas of the place, who, however, were of opinion that it must be something in the nature of a fish-spear. Later the object was brought to the attention of chief Leading Feather and certain other of the older members of the band, by whom it was at once recognized as a kind of arrow-point formerly used in the tribe for shooting muskrats and ducks. They called it, in fact, a rat-and-duck shooter, and they asserted that it was put to service by tying it securely at the end of an arrow, and despatching it from a wooden bow. Leading Feather and his friends had often heard of this weapon from old Ojibwa hunters, as one commonly employed by their tribe in ancient times, but at present superseded by fire-arms. Certain of the Red-Lakers claimed to have seen the implement in use during their boyhood. From all I could gather upon this subject, I judged that the rat-arrow was largely put in requisition at a former day, for destroying small animals which it was desirable to preserve unmangled.

FRANC E. BABBITT.

THE SUDAN.[1]

THE Sudan, in the broadest sense of the word, is bounded on the north by the Sahara, and on the south by the 5th degree of north latitude, except in the Nile region, where its southern limit may be fixed somewhat farther south. Between these boundaries, it stretches from the Atlantic Ocean to the highlands of Abyssinia and the Red Sea. The Sudan, as the word is commonly used at the present day, is the Egyptian Sudan properly so called, or the provinces belonging to Egypt lying south of the Nubian desert. These are, going from west to east, Dongola, Berber, and Suakin on the north; Darfur, Kordofan, Khartum and Senaar, Taka and Massawa, situated, roughly speaking, between 10° and 15° north latitude; and the southern Nile provinces of Fashoda, Bahr-el-Gazelle, and Equator. On many maps, however, the word 'Nubia' will be found as including all the Nile provinces as far south as Fashoda.

There is very little known of the history of this part of the world, but the following may be taken as approximately correct. The aboriginal inhabitants of these countries were undoubtedly negroes. It is not probable that the Arabs arrived much before the advent of Mohammed; but, in the eighth century of our era, one or more Arab tribes crossed the Red Sea, and settled in the Sudan as far west and south as Senaar. They became more or less amalgamated with the negro tribes, which they conquered and converted, and whose names they in many cases took. Thus it came about that the eastern Egyptian Sudan possesses at this day a reasonably homogeneous, impure Arab population, composed of the Hadendoa, Bishareen, and other tribes.

Kordofan lies approximately between 12° and 16° north latitude, and 29° and 32° east longitude. It contains a population of not over three hundred thousand. The Nouba (Nuba), a race of very black negroes, are not unlikely the representatives of the aborigines. They live by themselves in the mountains of southern Kordofan, and speak a language of their own. They are pure negroes. Between them and the Arabs there are two mixed races, the Ghodiat and Koungarra. It has been conjectured that the Ghodiat represent the ruling race at the time of the conquest of the country by the Fur, with whom the Koungarra seem to be allied; but this is largely conjecture. These tribes live in villages, and cultivate the soil. They are thus easily distinguished from the purer Arab tribes, the most numerous of which are the Kababish and the Bagarra, all of whom are real nomads. With the exception of the Nouba, the Kordofanese are Mussulmans, and very superstitious.

Kordofan was conquered by the chief of Senaar in the last quarter of the eighteenth century, and almost immediately wrenched from his grasp by the forces of the sultan or chief of Darfur, who retained possession of the country until the Egyptian invasion in 1821. Perhaps the following from Major Prout's report to Stone pasha will convey a good idea of the mixture of races in Kordofan, where, he says, to-day one may see "all the variety of face, form, and color, which is to be found from Italy to the land of the Niam-Niam."

These and other disturbances in the Sudan attracted the attention of Mohammed Ali in 1819, and he sent an army for its subjugation. This was easily accomplished, so far as Nubia, Kordofan, and Senaar were concerned; but the Red Sea littoral, Suakin and Massawa, was not incorporated until 1864. The cruelties of Ismail, Mohammed Ali's son, were so great that he and many of his officers were treacherously burned alive at Shendy; while the defterdar, his son-in-law, so misgoverned Kordofan that it is said that Mohammed Ali had him poisoned. This was the beginning of Egyptian rule in the Sudan, and its promise has been borne out by succeeding events.

In 1853 John Petherick, the English consul at Khartum, opened up the ivory trade of the White Nile. Other foreigners followed. It was soon found that slave-hunting was still more profitable, and their energies were accordingly turned in that direction. Seribas, or stockaded villages, were built throughout the Bahr-el-Gazelle country; but "about the year 1860 the scandal became so great that the Europeans had to get rid of their stations." They sold them to the Arabs, who paid a nominal rental to the government. The life of the Nubians and other Arab peoples under the oppression of the Turks, as they called the Egyptians, was so miserable, that whole communities betook themselves to slave-hunting. From Berber to Khartum "there was not a dog to howl for his lost master. . . . Thousands had forsaken their homes, and commenced a life of brigandage on the White Nile." Thus wrote Baker in 1869, and to the same effect Schweinfurth a year earlier.

It was to put a stop to this slave-hunting that Baker, and after him Gordon, were ap-

[1] It was originally intended to give this article to the readers of *Science* in No. 93, in which the map of the Sudan appeared, but it could not be prepared in time. — ED.

d governors of the equatorial Nile basin. succeeded in stamping out the trade in ovince of Equator, which was annexed pt in Baker's time. This province was ted exclusively by pure negroes; while l-Gazelle, where Schweinfurth lived so contained a large number of Arabs of or less pure blood.

er and Gordon undoubtedly suppressed ve trade of the White Nile, so far as it rried on by water; but how much the lave was benefited is another question. bly not much; for the overland march h Darfur and Kordofan must have been destructive of life than even the voyage owded Nile nugger.

of the most powerful of these ruffian of Bahr-el-Gazelle was Seebehr Rahama. seribas were near the Darfur boundary. during Schweinfurth's stay in the Bahr-elle country that Seebehr attacked and ed some government troops who had sent to take possession of a portion of rn Darfur. Seebehr himself then under-he conquest of that country. The Egyp-overnment, thoroughly alarmed at his g power, sent an army to co-operate, and was annexed to Egypt. This was in

fur, the land of the Fur, is situated be-9° and 16° north latitude, and 22° and st longitude. Its area is about one hun-and five thousand square miles. Very s known of the country; but the following gleaned from Dr. Nachtigal's communica-the French geographical society in 1876, e of interest. The population, estimated ut four millions, is as mixed as that of the entral Sudan provinces. The Fur, who the highlands, speak a language of their They are stigmatized by Nachtigal as vain, cowardly, treacherous, and as dis-ble as the Wadai on the west. They ck, of moderate height, with regular fea-and were the ruling race in Darfur before ming of the Egyptians. There, as in fan, there are many mixed races, and a Arab population, especially in the north-d central portions. It must be remem-that these Arabs of the Sudan are not rabs, but to a great extent merely Arab-egroes.

er Seebehr had conquered Darfur, he went ro for his reward; but, instead of being with honors, and sent back as governor rfur, he was made a pasha, and kept in on a pension. His followers, led by his leiman, in accordance with a preconcert-ed arrangement, rebelled; but Seebehr was not sent to quell the rebellion, as he had expected. The revolt was crushed by Gordon's able lieutenant, the lamented Gessi pasha, who became governor of Bahr-el-Gazelle. But upon Gordon's withdrawal, all power to do good was taken from Gessi, and he resigned.

In 1877 the khedive entered into an agreement with England, in which it was stipulated that the slave-trade should cease in lower Egypt on Aug. 4, 1884, and in the Sudan five years later. The rebellious spirit of the inhabitants had been suppressed by Baker, Gordon, and Gessi. It broke out again on the favorable opportunity which the revolt of Arabi pasha afforded. Mahomet Achmet, or El Mahdi, put himself at the head of the movement. A series of defeats was suffered by the government troops. Then came the worst blunder of all. A portion of Arabi's bashi-bazouks were sent to the Sudan under the command of Hicks pasha, a retired English army-officer. At first they were successful; but, when they attempted the invasion of Kordofan, they were surrounded, and cut to pieces. The Mahdi and his followers were supreme except in the immediate vicinity of a few garrisoned towns. It was at this juncture that Gordon was sent by the English government to report on the military situation in the Sudan. On his way he stopped at Cairo, and was commissioned governor-general of the Sudan without pay. His doings there are not known. It will be curious to see, whether when he again turns up, he still adheres to the following opinion, which he wrote just before setting out: "I am convinced that it is an entire mistake to regard the Mahdi as in any sense a religious leader: he personifies popular discontent."

NAVIGATION OF THE AIR.[1]

We have described in detail (*Science*, No. 86) the experiment made at Chalais-Meudon on Aug. 9, when for the first time a balloon returned to its point of departure.

In 1852 Mr. Henry Giffard, in a steam-screw balloon, obtained a speed of about 4 metres a second. In 1872 Mr. Dupuy de Lôme, with a motor worked by seven men, attained a speed of 2.8 metres; and the Tissandier brothers, with the first balloon furnished with an electric motor, a speed of 3 metres in 1883, and of nearly 4 metres in 1884.[2] Renard and

[1] From an article by Gaston Tissandier in *La Nature*, Nov. 15.

[2] By an experimental trip on Sept. 26, 1884, the brothers Tissandier proved that their balloon could be brought back to its starting-point in calm weather; but, through lack of funds, they

Krebs, by the use of a more powerful and a lighter motor and a long balloon, reached a speed of about 5.5 metres a second in their first two experiments, and 6.5 metres a second in their recent experiments of Nov. 8, 1884, or 23.5 kilometres an hour, with a five-horse power, and fifty revolutions of the screw a minute.

On the 9th of November, says Tissandier, the wind was moving at the rate of 8 kilometres an hour. When the balloon was going with the wind, its speed was equal to 23.5 plus 8 kilometres, or 31 kilometres, an hour: on the other hand, when it went against the wind, its speed was 23.5 kilometres minus 8 kilometres, or 15.5 kilometres, an hour. The balloon was easily guided in all directions.

The first ascent took place at noon. When the balloon had risen above the surrounding obstructions, the working of the screw was begun; and the balloon, tacking about, was directed in a straight line toward the viaduct of Meudon, which it soon reached. It crossed the Seine below the bridge of Billancourt, became entangled on the right bank of the river, and the motor was stopped, and the balloon allowed to go with the wind, in order to measure the rate of the current. After a rest of five minutes, the machine was again put in motion; and the balloon, guided by the rudder, described a semicircle of about 160 metres diameter, and returned to its starting-point at a slow rate, but with perfect stability. At three P.M. Renard and Krebs began a second experiment. The balloon arose a second time, and made several excursions in the neighborhood of Chalais; but the fog was so thick, that the second ascent only occupied thirty-three minutes through fear of losing sight of the landing-place. A return to the place of departure was easily effected, as before. The accompanying maps give the exact routes of the two trips.

These new experiments are decisive. Navigation of the air by means of long balloons provided with screws is demonstrated. We will repeat, what we have already said many times, that to be practicable and useful, aerial ships must be made very long, of very large dimensions, which shall carry very large machines, capable of giving a speed of from 12 to 15 metres a second, allowing their working at almost any time. When the wind is high, or there is a squall or tempest, aerial ships must remain in port, as other vessels do. It becomes now only a question of capital.

have not been able to provide a shelter for the inflated balloon, that it might be ready to set out in favorable weather.

A NEW LAW OF ORGANIC EVOLUTION.

I HAVE in another place given many reasons for believing that the male cell has, by division of labor, gradually acquired the function of exciting variation, while the ovum transmits the established characteristics of the race. The following facts, among others, seem to indicate that a specialization of this sort actually exists. 1.° There is no evidence that the functions of the two sexual elements are alike, but the possibility of parthenogenesis shows that the ovum in itself can transmit all the established characteristics of the race. 2°. Organisms born from fertilized eggs or seeds are much more variable than those which are produced asexually. 3°. The children born from a male hybrid with the female of either pure form are much more variable than those from a female hybrid with the male of either pure form. 4°. Parts which are confined to males, or which are of more functional importance in males than in females, are much more variable than parts which are confined to females, or which are of more functional importance in females than in males. 5°. Males are more variable than females. 6°. The male leads, and the female follows, in the evolution of new features, as is shown by the fact that the females of allied species are more like each other, and more like the young, than the males are. This cannot be due to sexual selection; for it holds true to a remarkable degree in domesticated pigeons, and in other animals which are paired by the breeder.

Now, if it is true that the tendency to vary comes through the influence of the male parent, it will be for the advantage of the species to give birth to an excess of females, so long as the conditions of life are favorable, and change is not needed, and to give birth to an excess of males whenever the conditions of life become unfavorable, and thus demand new modifications.

Düsing has recently published [1] a very valuable and highly suggestive series of papers upon the laws which regulate the sex of the embryo in mankind, and in other animals, and in plants; and the facts which he has brought together seem to show that this specialization actually exists, and that a favorable environment

[1] *Jenaische zeitschrift*, xvi. iii. 1883, 428, and xvii. 1884, 593-940.

an excess of female births, while an unfavor- …vironment causes an excess of male births.

…ng mankind the conditions of life are so much …control, that it is difficult to say just what con- …s a favorable environment; but I think we …fely conclude that a high birth-rate indicates …e conditions of life are favorable, and that a …e in the birth-rate indicates decreased pros- … and that human races which are disappearing …doing because surrounding conditions are no …favorable.

…ng gives many facts to show, that, as the birth- …creases, the number of boy-births to each 100 …ths decreases, and *vice versa*. At the Cape of …Hope the Boers are very prolific: six or seven …all family, and from twelve to twenty children … unusual, and 100 girls are born to every 97.2 … The Hottentots, on the other hand, are very …e: many of the women are barren, and they … have more than three children, and 103.9 boys …n to each 100 girls.

…birth-rate is higher in towns than it is in the …y, and the ratio of boys is greater in the coun- …n it is in the towns. In 1881 the average for …ole of Prussia was 106.36 boys to each 100 girls; … all the towns the boy-births were below this …, and above the average in the country. Ploss …own that in Saxony the ratio of boy-births …d falls with the price of food.

… nearly 10,000,000 births, Düsing has compiled … to show the birth-rate, and the ratio between …es, for each month in the year; and this table … that the ratio of boy-births is the highest …he birth-rate is lowest. In March the birth- …s highest (942,488), and the ratio of boy-births …vest (105.92 boys to each 100 girls); while in …e birth-rate was lowest (812,469), and the ratio … highest (106.77).

…ng the lower animals, it is difficult to obtain …s: but Düsing states that domesticated animals …re prolific than their wild allies, and that there …eater number of female births; that, when … are taken from a warm to a cold climate, the … male births increases; and that leather-dealers …at they obtain most female skins from fertile … with rich pastures, and most male skins from …arren countries.

…power of parthenogenetic reproduction seems, …y cases, to have been acquired in order to …an unusually great and rapid increase in the …te, when the conditions of life are unusually …le; and in these cases the parthenogenetic eggs …th to females almost exclusively. Among the …ogenetic Cladocera, both males and females …nd in the fall and in the early spring; but dur- … warm months only females are found, and …ultiply so rapidly, that, according to Ramdohr, …e Daphnia can in sixty days produce 1,291,- … parthenogenetic female descendants. As the …of food fails in the fall, males make their ap- …e; and Kurz has shown that any unfavorable … causes the production of males. He says …les appear when food fails, when the water dries up, when it becomes too dense, when it acquires an unfavorable temperature, or, in general, when there is a decrease in prosperity. From these and many other facts recorded by Düsing, I think we may safely conclude, that among animals and plants, as well as in mankind, an unfavorable environment causes an excess of male births, and a favorable environment an excess of female births.

Now, why should this be so? If the welfare of the species can be secured, under a favorable environment, by females alone, why are males needed when the environment becomes unfavorable? I believe that we have, in the facts recorded by Düsing, an illustration of one of the most important and far-reaching of all the adaptations of nature, — an adjustment which tends to cause variation when it is needed, and to keep things as they are, so long as no change is demanded. As the conditions of life become unfavorable, variation becomes desirable in order to restore the adjustment between the organism and its environment; and this is secured by an increase in the ratio of male births.

That this is the true explanation of the phenomena, is shown, I think, by the contrast between domesticated animals and captive animals. The fact that an animal has become domestic shows that it finds in captivity a favorable environment; and Düsing says that domestic animals are exceptionally fertile, and that they produce an excess of females. Animals which are kept as captives in menageries and gardens, have, as a rule, no fitness for domestication; and Geoffroy St. Hilaire says that individuals born in menageries are usually male, while skins sent to museums are usually female; and that the attempt to domesticate a wild animal increases the number of male births. Düsing states that captive birds of prey, and carnivorous mammals, are very infertile, and that the young are nearly always males.

The wild human races of Oceanica and America are much like captive animals, as they have been suddenly thrown into contact with a civilization which has been in Europe the slow growth of thousands of years. Food and climate have not changed, but a new element has been introduced into their environment. The New-Zealanders are very infertile, and nearly all the children are boys; and the census of 1872 for the Hawaiian Islands gave a ratio of 125 male births to each 100 female births.

I believe we may see, in these instances, the last struggle of nature to save the race from extermination by the production of a favorable variation. It is proper, however, to point out that Düsing himself gives a different explanation of the excess of male births under unfavorable conditions of life, although I believe that examination will show that his explanation is inadequate.

He says that the excess of male births is for the purpose of preventing close inter-breeding. He shows that inter-breeding causes sterility, small size, and lack of general vigor and vitality; and he also shows that these effects are most marked when the other conditions of life are least favorable, and that no evil effects follow inter-breeding when food is abundant,

'democratic federation,' and at least periodicals of a radically socialistic na- re supported, — viz., the monthly *To-* nd the weeklies *Justice* and *Christian st*, — while Hyndman's books, 'England ,' 'The historical basis of socialism,' ave certainly attracted wide discussion, ve also the contributions of the poet to the literature of socialism. Ameri- ocialistic movements likewise receive y inadequate attention; and the im- n is conveyed that there is practical- American socialism, — a most radical

of the peculiarities of modern socialism nexpectedness wherever it makes its ap- ce. This is brought out in several places Rae. Referring to German socialism, 61 he says, "Professor Lorenz von of Vienna, . . . who wrote an acute oughtful book on French communism in says in that work, that Germany, unlike , and particularly England, had nothing from socialism because Germany had no riate to speak of. Yet in twenty years l Germany become suddenly the theatre most important and formidable embodi- f socialism that has anywhere appeared." a correct statement. Again and again said that communism was a French , from which Germany had nothing to s her peace-loving, laborious, frugal, and ted laborers could never become infected e poison of discontent. Now, to use a stic phrase, she leads the labor battalions world. Less than ten years since, men boasted that socialism was a conti- plague, from which the free institutions land, and the manly, self-reliant char- f her sons, forever exempted the British ow it is doubtful whether socialism has re a more respectable following, and e government is influenced by socialistic A tinge of socialism is diffusing itself e institutions of England, the classic f *laissez-faire*. And in America how has been our self-confidence! With tisfaction have we pointed to our broad , offering homes to all! With what con- nt have we talked about the prosperity merican laborer! With what scorn have rred to the pauper labor of Europe! no sane man could expect a social like socialism in the United States. e it is, and it is nowhere making more trides. The proof of this is on every It is but necessary to open one's eyes, tch the movements of the laboring classes. Their parades, mottoes, labor-unions, newspapers, conventions, and congresses tell the tale; but of all these, Rae has little or nothing to say.

The book is timely, and it is unfortunate that our author did not do himself better justice in a more carefully prepared treatise.

THE FACE OF THE EARTH.

Das antlitz der erde. By E. SUESS. Abteilung i. Leipzig, *Freytag*, 1883. 310 p., illustr. 4°.

DR. EDUARD SUESS of Vienna, well known among geological readers for his original writings on the structural relations of earthquake disturbances and on mountain building, has in preparation a more general work on the 'Face of the earth,' in which he attempts, by a

OVERTURNED FOLD IN THE MAMRANG PASS.

critical review of recent studies, to correct a number of surviving errors, and prepare the groundwork for an unprejudiced view of dynamical geology. The first part of the work, already published, contains a discussion of motions in the outer crust of the earth, and of the structure and course of some of the larger

mountain ranges. Under the former heading there is an extended essay on the deluge, which has been printed apart, and briefer chapters on earthquakes, dislocations, and volcanoes. The second heading includes, thus far, only the Alpine system.

The work shows a broad acquaintance with the subject; and, in spite of its title, it is not a 'popular' book. Yet its style is much more attractive and readable than one usually expects in a geological essay. Among the more novel topics, there may be mentioned the brief account of Fischer's and Hann's studies of the deformation of the ocean's surface by continental attraction; a summary of the evidence

RESTORATION OF A DISTURBED REGION OF PALEOZOIC ROCKS IN BELGIUM.

contradicting the often quoted elevation of the Chilian coast in the earthquakes of 1822, 1835, and 1837; the series of forms developed in an eruptive region by deeper and deeper denudation; and the relations of the curved trends of the Alpine system to the generally northward tangential thrust that produced it.

A moderate number of well-executed cuts, and several long lists of authorities, add to the value of the work. The first of the illustrations here copied shows an overturned fold on the Mamrang pass, in the north-western Himalaya: the second is a restoration, by Cornet and Briart, of a greatly disturbed region of paleozoic rocks in Belgium, over part of which cretaceous strata are laid unconformably. Of the three great faults, *AA* is the oldest, and *CC* the youngest.

A POPULAR WORK ON AMERICAN NATURAL HISTORY.

Tenants of an old farm, leaves from the note-book of a naturalist. By HENRY C. MCCOOK, D.D. New York, *Fords, Howard, and Hulbert*, 1885. 456+4 p., illustr. 8°.

SCIENTIFIC men are accustomed to consider themselves an exclusive body. They collect bits of knowledge, which they seem to look upon as their private property, and, either wisely or unwisely, spend their time making observations, and rigidly describing them for scientific ears, with no attempt to put the material within reach of the ordinary mind. The result is, that the popular books of science, from which the general reader must get his information, are usually compiled by persons who have never seen what they are describing, but have obtained their information entirely from others. A book like the one before us is therefore of special value, for we have in it a popular account of scientific subjects by one who has himself observed every thing he describes. The scientific statements of the author are not only reliable, but, coming directly from nature, they still retain evidence of direct contact with life, which is so sure to disappear with too many repetitions; and when, further, these statements are put in a form to appeal to the general reader, we may be sure of an addition, perhaps not to science, but to the knowledge of the reading public.

The author informs us, that under the persuasions of friends, and rather against his own inclination, the plan of the book is colloquial in form. What the book might otherwise have been cannot be said, but the persuasion of friends seems here to have had a happy effect. The desirable quality of a popular scientific book is to obtain as many readers as possible, and thus spread the knowledge widely. However interesting facts of natural history

: in themselves, it yet remains true that more interested in man than in any thing and scientific information given in the f conversations, as in this book, is not iore interesting, and sure to obtain more s, but makes a much more lasting im-on.

plan of the book is this: a city mer-who was formerly a naturalist is ordered doctor to take a year's rest in the country. eys the order, and occupies his time, regaining health, in resuming his old ntance with the insect world. Various s are introduced, who become interested oddities found, and weekly conversations household upon insects are the result. uthor, assuming the character of the list, details to his listeners a great many sting and valuable bits of information their natural history: their life-history abits, the damage which they do, with onally the method for its prevention, scussed. A classical student introduces ythology and classical lore relating to the t; two farm-hands are thoroughly ac-ted with the various superstitions con-l with insects; the peculiar habits give tunity for occasional moral lessons; while ool-ma'am' enlivens the party with her The classical student, being a clergyman, to introduce the relation of evolution gion, and is made to say, "As a method ation simply, I am willing to leave it in nds of the naturalist and philosopher," onclusion which, happily, is being reached thinking men. In short, these conversa-and the experiences detailed, give to the ientific reader a pleasant and accurate ac-of many of the animals which he is sure et in his walks in the country. The work a scientific one. It is true that there are new observations given; but they are so ped in the general character of the book heir value disappears, for no naturalist be apt to go to a book of this nature for ific information.

: illustrations form not the least attractive e. These are very numerous, — about a ed and fifty in all, — all new, and drawn ally for this work. Of themselves, they nsure many a purchaser. It is some-to be regretted that so many of them are humorous in nature. The whimsical es of Mr. Beard are certainly unique and ent, but seem somewhat out of place, to the pages the appearance of humorous ions. While they do somewhat enliven ok, the reader cannot help wishing that their place were filled with more of the sketches from nature from the author's sketch-book, whose excellence is verified by the many examples given.

NOTES AND NEWS.

GEN. F. A. WALKER, of the Massachusetts institute of technology, has published a brief paper on industrial education, which he read before the American social science association in Saratoga last September. This interesting paper bears upon the questions which are under discussion in Glasgow. Gen. Walker offers the following classification of schools devoted to industrial education: —

1. Schools of applied science and technology, such as the school over which he presides, the Sheffield scientific school, the Stevens institution, the Rensselaer polytechnic institute, and the like.

2. Trade-schools, in which a particular art, or branch of industry, is taught; as, for example, watch-making in Switzerland.

3. Schools in which manual and mechanical education is introduced as a part of the general education of the scholar with reference to the fuller development of all his powers, not to make an engineer on the one hand, nor a trained operative on the other.

Gen. Walker advocates with clearness and vigor the gradual introduction of manual training in the public schools, and sketches what he calls 'a fairly conservative programme,' which would involve only a slight disturbance of the structure of the existing schools, but would call for a surrender of a considerable portion of time to the new studies. Gen. Walker seems at a loss for a phrase or term with which to indicate the training he desires to give. We suggest 'handicraft.' Let handicraft be taught in every school for girls or boys, in the kindergarten, and in the scientific laboratory. 'Handicraft' will make a good rallying word for all who favor this new phase of popular education.

— We would call the attention of our readers to the following remarks by Sir William Thomson during an address at Philadelphia last summer: "You in this country are subjected to the British insularity in weights and measures: you use the foot and inch and yard. I am obliged to use that system; but I apologize to you for doing so, because it is so inconvenient; and I hope all Americans will do every thing in their power to introduce the French metrical system. I hope the evil action performed by an English minister whose name I need not mention, because I do not wish to throw obloquy on any one, may be remedied. He abrogated a useful rule, which for a short time was followed, and which I hope will soon be again enjoined, that the French metrical system be taught in all our national schools. I do not know how it is in America. The school system seems to be very admirable; and I hope the teaching of the metrical system will not be let slip in the American schools any more than the use of the globes. I say this seriously. I do not think any one knows how

seriously I speak of it. I look upon our English system as a wickedly brain-destroying piece of bondage under which we suffer. The reason why we continue to use it is the imaginary difficulty of making a change, and nothing else; but I do not think in America that any such difficulty should stand in the way of adopting so splendidly useful a reform."

— Professor George Davidson of the Coast and geodetic survey, San Francisco, informs us that the account of the volcanic eruption of Mount St. Augustin, Cook's Inlet, Alaska, prepared by him, and published in *Science*, No. 54, Feb. 15, 1884, was wholly derived from an account by Capt. Sands, and is seriously in error. It appears that Capt. Sands saw the eruption only from a distance of about fifty miles, in unfavorable weather, and therefore derived his information about details from the natives or from his imagination. The splitting of the island in twain, the formation of new islands, etc., appear not to have occurred. According to Capt. Cullie of the Alaska commercial company, who visited the island, there has been a great land-slide on the north-north-west side of the mountain, leaving a precipitous bluff over which has poured lava and eruptive matter filling up the rocky boat-cove there. He further reports that a reef running westward, and formerly submerged, is now elevated to the sea-surface. The volcano above the great slide was actively smoking or steaming at the time of his visit last summer. This information is in confirmation of that printed in *Science*, No. 73, June 27, 1884.

— Lord Rayleigh has resigned the Cavendish professorship of experimental physics at Cambridge, Eng.

— The department of biology of the University of Pennsylvania was formally opened on the 4th with an inaugural address by Professor Harrison Allen, one of the principal promoters of the enterprise.

— Mr. H. E. Dore of Portland, Ore., has discovered Zonites cellaria Muller somewhat abundantly in that city, while the native helices appear to be receding from the vicinity of civilization. The intruder, now for the first time reported from that region, is a European species living in damp places, and apparently with a *penchant* for travel. It was introduced at Charleston, S.C., nearly a century ago, and described by Say as a new species. It has been found along our eastern coast in many cities, and in Manila, Japan, the Hawaiian Islands, and many other widely distant regions which are visited by European ships, and seems to flourish equally well everywhere.

— In the journal of the Anthropological institute of Great Britain for November, 1884, Dr. Flower discusses the size of teeth as a race-character in man. His observations were made upon all those skulls, out of the three thousand in the collection of the museum of the Royal college of surgeons, which retained the bicuspid and molar teeth of either side in the upper jaw. These five teeth he measured in a straight line along the crowns, from the anterior margin of the first bicuspid to the posterior margin of the last molar, to get the 'dental length.' This absolute length is not sufficient in comparing races, for smaller races might naturally be supposed to have smaller teeth; so that it was necessary to find some standard of length as indicating the general size of the cranium, with which to compare the dental length. For this purpose, there was chosen the length of the base of the skull from the anterior margin of the foramen magnum to the point where the nasal bones are set upon the frontal. The expression in figures, of the proportion between the length of these five teeth and that of the base of the skull, is known as the 'dental index.' The average dental indices of the human races represented in the collections examined range between forty and forty-eight: and for convenience of classification they are divided into microdont, with proportionally small teeth, index below forty-two; mesodont, with medium-sized teeth, index between forty-two and forty-four; megadont, with large teeth, index above forty-four. Six gorillas, six chimpanzees, and as many orangs, examined, were found to be strongly megadont; while a male siamang proved to have molar teeth scarcely larger, in proportion to the skull, than the higher races of man. The megadont human races are the Tasmanians, Australians, Andamanese, and Melanesians of various islands. The mesodont races are the African negroes of all parts; Malays of Java, Sumatra, etc.; American Indians of all parts; and the Chinese. The microdont races are the low-caste natives of central and southern India; the Polynesians; the ancient Egyptians; mixed Europeans, not British; and the British. While the separation into groups is necessarily arbitrary, it seems to be not wholly unnatural, since it accords in a general way with the familiar classification based on color; the microdont section including all the so-called Caucasian or white races, the mesodont the Mongolian or yellow races, while the megadont is composed exclusively of the black races, including the Australians.

— The Royal academy of sciences in Turin celebrated its hundredth year in July, 1883, and, in commemoration of its centennial, has issued a quarto volume of nearly six hundred pages. In this may be found biographical sketches of the three founders of the academy, — La Grange, the famous mathematician; Saluzzo di Monesiglio, the physician and chemist; and Cigna, the anatomist and natural philosopher. The two first named were successively presidents of the academy; and they were followed by Morozzo, a physician and mathematician. His name is followed by that of Napoleon Bonaparte, who was chosen president while he was first consul. A brief history of the academy is given, and lists of the officers and members, an analytical table of the contents of the society's transactions, and, finally, an elaborate alphabetical index to names and subjects mentioned in the transactions. Among the associates of the academy are our countrymen, James D. Dana and George Bancroft, who are foreign members, and William D. Whitney, who is a corresponding member.

— Prof. T. C. Mendenhall has been appointed chief electrician of the U. S. signal-bureau.

as discoverer was entitled to name. This supposition by those better informed was ascribed to imperfect charts; and it was supposed that the really important additions to geographical knowledge, made in the course of this exploration by Lieut. Stoney, entitled the hasty un-

the cabinets of the early naturalists, such as those of Say, Hentz, and Melsheimer, remained in this country; for almost without exception the specimens have been totally destroyed through neglect. There is not to-day more than a single museum in the country, where proper pro-

vision is made for the preservation of such perishable collections as dried specimens of insects. Under the present condition of things, it is actually unfortunate for the future of this science, when an enthusiast arises in some local museum whose care for and interest in these objects result in the accumulation of a considerable collection, often containing valuable types. At his death or removal, or possibly the failure to retain his early ardor, the chances are ten to one that the collection will be ultimately destroyed. Even our best endowed institutions have failed to make any proper provision for the preservation of their collections of insects and stuffed animals, — the two departments of a natural-history museum which require eternal vigilance.

There are many valuable entomological collections in the hands of specialists in this country, which would find their way by gift, or by sale on easy terms, to the National museum at Washington, were any reasonable inducement held out to them. These collections contain material especially valuable for the future of descriptive entomology in this country. Within a few years many such collections have been sold, either to other private collectors, or perhaps to parties out of the country, to find their place in European museums, where they are insured perpetual care. It is only within three years that there has been even a nominal curator in charge of the collection of insects at the National museum; and the paltry collection of the department of agriculture was all the authorities at the national capital had to show for an entire department of natural history, and one abounding in its wealth of varied forms. The present curator has but an honorary office, and is without funds for the support of an assistant. Until provision is made for the proper conduct of this immense department of natural history at the national capital, the appointment of an honorary curator is worse than useless. It only deceives those who know no better, into the supposition that collections sent to the museum are insured proper care. They are not.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible.
writer's name is in all cases required as proof of good f*

Verification of predictions.

THE vulnerable point about Mr. Doolittle's r
ure of success (given under 'Proceedings of socie
in this number of *Science*) seems to me to be his
bination of the two differences of probabilities,

$$\frac{c}{o}-\frac{p-c}{s-o} \text{ and } \frac{c}{p}-\frac{o-c}{s-p}.$$

It appears clear to me that either of these differ
may be taken alone, with perfect propriety, a
true measure, according as our concern is to te
currences for successful prediction, or to test p
tions for fulfilment. If we allow an importa
to the former test (limits of n, 0 and 1), so that
valorem change of δ in this measure produce
ad valorem change of $n\delta$ in i, and similarly a
portance $1-n$ to the latter test, these two quan
will enter as exponents, and

$$i=\left(\frac{c}{o}-\frac{p-c}{s-o}\right)^{n}\left(\frac{c}{p}-\frac{o-c}{s-p}\right)^{1-n}.$$

In my opinion, the value of i is not discove
unless the value of n is given; and this is a subj
quantity. Assuming $n=\frac{1}{2}$, we have for i an e
sion equal to the square root of that given b
Doolittle, and without the fault of giving no neg
values to answer to perverse predictions.

HENRY FARQU

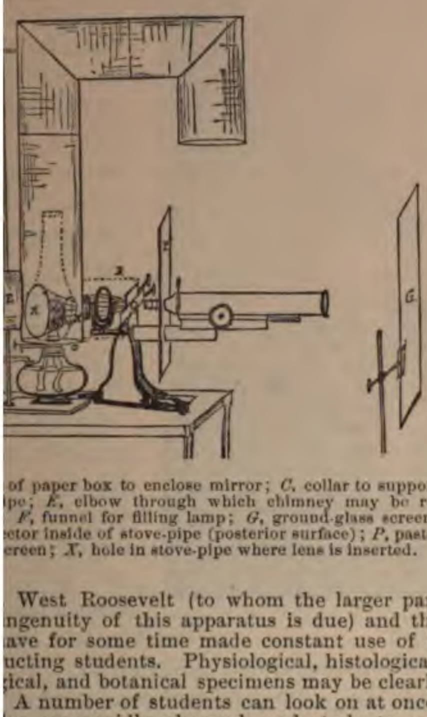
The microscope for class-room demonstra

The following adaptation of the use of the m
scope as a sort of magic-lantern for class demo
tion has been found so extremely useful, cheap
practical, that it is illustrated here.

A large common kerosene 'duplex' lamp i
illuminator. Superfluous light is cut off by a
of six-inch stove-pipe, which fits over the lamp-
ney, and rests upon a horizontal collar, *C*, of
pipe metal. The collar prevents the pipe
shutting down too far upon the lamp, which
cause the kerosene to become dangerously hot.
lamp is filled at *F* with a curved glass funnel; a
two flat wicks, an inch and a half broad, are t
by their separate keys outside of the pipe. Th
has two elbows, which conduct heat and smoke
and completely cut off the light from the top
flame. These elbows may be rotated into an
venient position. Opposite the lamp-chimney
short elbow, *E*, is inserted, closed by a movabl
Through this elbow the chimney can be remov
wicks trimmed, and a concave glass or tin ref
M, four inches and a half in diameter, may be
behind the flame. The flat of the wicks sho
parallel to this mirror. Opposite the mirro
directly in front of the flame, a plano-convex le
two inches in diameter, is inserted in a hole
pipe. The light reflected from the mirror, *M*,
through this lens, and falls upon the reflector
microscope, whence it is made to illuminate
ject upon the glass slide in the ordinary way
object is magnified by a one-fifth inch or one-ha
objective; the eye-piece of the microscope is rem
and the image is projected upon a ground-glass
G, a foot and a half square, which is placed
one to four feet in front of the microscope
screen is supported by a perpendicular iron r
cork-lined clamp, such as is in use in every ch

y, to hold glass retorts, tubes, etc. The iron upon the floor, occupies very little space, and loved to any convenient focusing distance. stand supports the horizontal elbow of the . The tube of the microscope should be l inside as in micro-photography. The pe is handled in every way as usual in stage movement, fine adjustment, etc.

eat difficulty with the apparatus consists in prevent the reflection of superfluous light. e this, a pasteboard box, *B*, six by six by eight s readily cut to fit closely over the plano-ens and the back of the microscope stage, osing the microscope reflector, and allowing to be focused properly when the lid of the moved. It is also advisable to fit a sheet of rd, *P*, tightly over the microscope tube at les to it, in order to cut off the rays which round the object illuminated, pass along the ision outside of the tube, and tend to blur e on the screen.



of paper box to enclose mirror; *C*, collar to support ipe; *E*, elbow through which chimney may be re- *F*, funnel for filling lamp; *G*, ground-glass screen; ector inside of stove-pipe (posterior surface); *P*, paste-creen; *X*, hole in stove-pipe where lens is inserted.

West Roosevelt (to whom the larger part ngenuity of this apparatus is due) and the ave for some time made constant use of it ucting students. Physiological, histological, gical, and botanical specimens may be clearly A number of students can look on at once. les are rapidly changed, and students and or may always be sure that they are discuss-same particular cell; which, unfortunately, is case when a beginner in the use of the micro-oks through the instrument alone. The is may readily be constructed by any one for ve dollars: it is easily portable, and always r use in any darkened room. It is possible w the light from the lens *X* directly upon ect without the intervention of the micro-flector, but the reflector facilitates focusing. es of wide aperture are preferable. With ses, the use of the eye-piece adds distinctness, most cases it cuts out too much light. An luminator may be inserted. The image on en *G* is seen most distinctly upon the farther d some objects become clearer if the screen be moistened with water, or covered with a thin coat of transparent varnish laid over the ground surface. The image may also be received upon white glazed paper, but this is less clear.

For demonstration on a larger scale, an oxy-hydrogen light can of course be used, or some form of electric light. The arc-light is not sufficiently steady, and the incandescent light requires a great deal of storage-room for batteries. The light above described shines with thirty-six candle power, is clear and steady, and serves every ordinary purpose: the circulation in the frog's foot, varieties of epithelium, injected lung tissue, tubercle, plant-cells, etc., may all be clearly shown. The colors of stained or injected specimens come out distinctly.

The principle of this apparatus is by no means new; but its application is made so easily within the reach of any one who owns a microscope, that it is especially recommended to instructors in schools and colleges.

W. G. THOMPSON, M.D.

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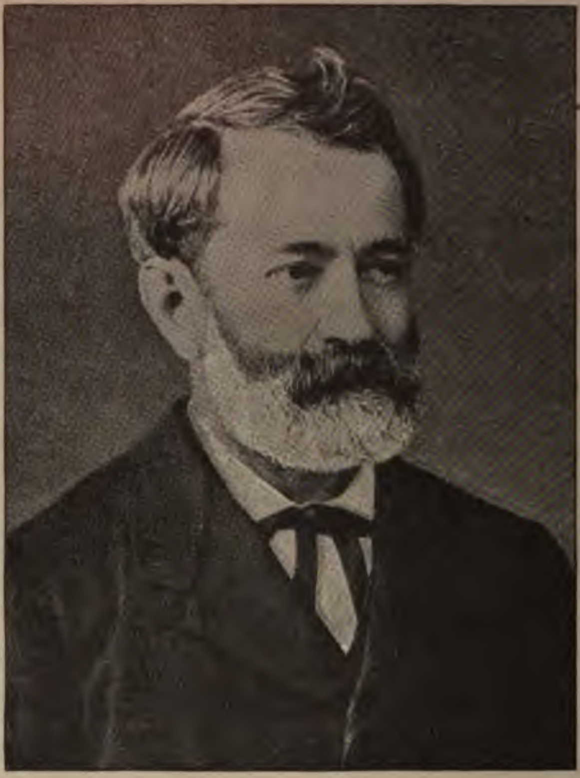
QUINTINO SELLA.

QUINTINO SELLA was born July 27, 1827, at Mosso Superiore, a little village on the Biellese mountains, and pursued his early studies at Biella, evincing a special aptitude for the classics. Later he completed a course of study in mathematics and physics at the Turin university, and obtained the degree of hydraulic engineer. He then entered the school of mines at Paris, and passed the following five years, partly in study, partly in travelling through Germany and England. His studies were much interrupted by the political excitement of 1848, and he was an interested witness of all the stirring events from the fall of Louis Philippe to the proclamation of the second empire. At Paris he made the acquaintance of Gastaldi, with whose co-operation he later founded the Valentino museum. After his return to his home in 1852, he would have entered the service of the royal corps of mining engineers; but Savoy being the only district vacant, and not being able, on account of private business and his somewhat impaired health, to reside there during the winter, he remained at Turin, where he became professor of geometry at the technical institute, and where he married Clotilde Rey. In June of the next year he went to Savoy, and remained till the autumn, when he was appointed temporarily professor of mathematics at the university of Turin. In 1856 he was admitted into the corps of mining engi-

neers, and was given charge of Turin district and the regency of that of Coni.

In 1859 he was made a member of the council of public instruction, and in 1860 of the council of mining engineers. Since 1856 he had had the care of the mineralogical cabinet of the technical institute, which later became the school of application, and where in 1860 he was appointed professor of mineralogy. Here his active scientific work ended. Sella's political career began in the following year, when he was elected representative of Cossato (Biellese), in which capacity he was serving at the time of his death. In the same year also he was general secretary of the minister of public instruction, and held the office for some time gratuitously. Three times he was the minister of finance, the first time in the Rattazzi cabinet, when he had had no experience in politics, and as the successor of Cavour. Then began that gigantic but successful struggle with the enormous debt of the Italian treasury which saved the national honor and fortune. To him also was largely due the construction of the Palazza dei finanze.



In 1873 he withdrew for an indefinite time from politics, and accepted the presidency of the Accademia scientifica dei lincei, and obtained its removal to the Corsini palace.

His mineralogical and geological publications were numerous. One of the most important of the former was his account of the mineralogical industry of Sardinia, in which he gave the general statistics and description of the mines and smelting-works of the island, with their technical and economical condition, and proposed a plan for their improvement, and in which he touched upon the important question of the ownership of mines. In 1881 he was made honorary president of the international geological congress; and at that time, in conjunction with Professor Capellini, he founded the Italian geological society. His principal geological work was his map of the Biellese district; and he was intending to make a detailed study of the Biellese Alps in the interests of geology. He was the founder and president of the Italian alpine club, and of his work in this branch much might be said.

So passed away, in his fifty-seventh year, a man the useful period of whose life, coinciding with that of the re-organization of Italy, contributed much to its formation. Italy was not unmindful of his services. Public funeral honors were granted him, parliament decreed a national monument at Rome, and various testimonials were offered by different cities and organizations, among which may be mentioned the medallion presented by the royal corps of mining engineers.

Our portrait represents him at the age of thirty-six.

'HE NETSCHILLUK INNUITS.

Netschilluk Innuit, or Eskimo, have ariously spoken of as Neitschilluk, Net-e, Nachillee, and Nachilluk, by various . The name comes from Netshuk, or huk, meaning the small seal of the Arc-d is no doubt due to their being depend-on the seal as their staple article of So important a factor is the stomach of kimo, in his economy, that his diet often ines his tribal name; but the significance name has in many cases vanished, either ount of tribal migration, or the extinc- the animals upon which they were de-t.

nd the Netschilluks, in 1879, living on the nd opposite King William's Land, and the islands in the vicinity of Simpson's They were most numerous along the rn shores of Adelaide Peninsula, their s being scattered every few miles along ast from the Montreal Islands to Smith's Farther east were the Pelly Bay Eski-ith whom the Netschilluks get along ough, and through whose country some igrated to Hudson's Bay. To the south-ere the Oogueesik Salik Innuit, a nearly tribe, the few remaining members living Dangerous Rapids of Back's River, and Rapids of Hayes River. Between nd the Netschilluk, there exists the t distrust. From Smith's Point to ghlin Bay, along the western shore laide Peninsula and in King-mik-took Inlet), there live the Ookjoolik, or lik, with whom the Netschilluks are in-y associated. Still farther west are the ik (copper Eskimo); and between them the other tribes I have mentioned, there open hostility, — the only case I know the whole family of Eskimo. This y, however, takes more the form of us efforts to avoid each other, than to n collisions, though occasionally such r.

Netschilluks, in weight and stature, are the Caucasian race. The Eskimo of and have been so often described, and are ly so undersized, that this characteristic wittingly been attributed to the whole Among the Eskimo of North Hudson's occasionally found a man of even con-s size. One of these was the only fully Netschilluk on the shore of the bay; etermined to have him in my sledging-r King William's Land, as he would be of introduction. He was named Ik-gueesik, stood about six feet high, and weighed perhaps from two hundred and twenty to two hundred and thirty pounds, every ounce apparently serviceable muscle. He proved to be a by no means exceptional specimen of his race, one whom I met standing over six feet six inches. Those of shorter stature were of exceedingly heavy build, with stout frames and broad shoulders. A cadaverous-looking specimen (fig. 1), whom we met for the first time as

FIG. 1.

we were leaving his country in November, could hardly be called an exception, when his story is told. As soon as the ice in the fresh-water lakes is melted in July, this tribe leaves the coast to hunt reindeer. Our friend, having chosen a very unfrequented sheet of water for his summer reindeer-hunt, was left one day upon an island with his kiak wrecked, and, when rescued many days after, was at the point of death from starvation. He was brought to the coast in the fall, and when we saw him, although unable to walk alone, had overcome this difficulty by harnessing a strong dog, and tying the trace around his waist, and, with a long cane or staff, could make good headway as a pedestrian.

The Netschilluks know nothing of fire-arms. Their bows are made of spliced pieces of musk-ox horn or driftwood, and cannot compare with those of the American Indians. Their method of hunting reindeer is to build a line of stone monuments (fig. 2) of about a man's size, from fifty to a hundred yards apart, on some ridge often two or three miles in length, which runs obliquely (fig. 3) toward some large lake or wide river. If a herd of reindeer is seen between the line of cairns and the water, the natives deploy into a skirmish line across from the last cairn to the river, and walk slowly toward the reindeer, their weapons and their kiaks being concealed near the water's edge.

The reindeer, seeing their enemy, trot away until they come within sight of the piles of stones, when, believing themselves to be sur-

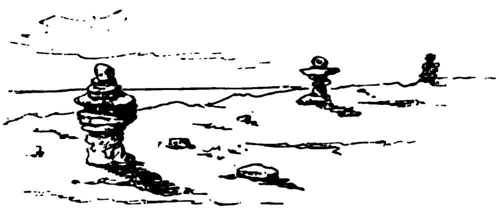


FIG. 2.

rounded, they take to the water. Then the Innuit follow in their kiaks, and easily overtake the bewildered animals. A herd of reindeer, when undisturbed, will repeatedly graze near such a line of cairns without any further notice than a few suspicious glances.

Depending as they do upon such a precarious chase, the Netschilluks are poorly clothed. As they live nearest to the pole of minimum temperature, it is interesting to note their methods of combating the cold. Their igloos are the warmest I saw in the Arctic: they are very low, as shown in fig. 4, the dotted lines indicating the usual height. With such a cramped space, the heat from the lamp and

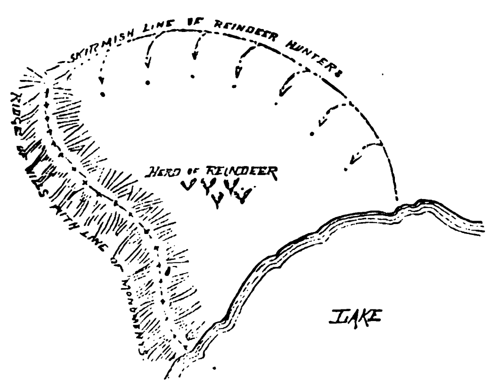


FIG. 3.

from the bodies of the Innuit is naturally economized to the utmost.

They have an unlimited supply of seal and ookjook (great seal) oil for lamp-use, while they devour enormous quantities of seal-blubber. Their consumption of fat, even during the summer and autumn months, when I saw them, was noticeably greater than that of other tribes. Their reputation for thieving is not conspicuous, and they generally tell the truth. They treat their children well, especially the boys, but still practise to a limited degree female infanticide. They have the usual superstitious beliefs of savages, but are to be credited with having devised a physical theory to account for a physical phenomenon. They never have seen wood growing, and only know it as driftwood scattered on the shore. They see the logs frozen in the ice before they are cast upon the shore, and believe the timber to be a growth on the bottom of the ocean (fig. 5), which, when it reaches to a certain height, is nipped off by the ice, and borne to the land. It was on one of their wood-seeking trips that the Netschilluks learned so much regarding the ill-fated Franklin party. These trips are at rare intervals; and wood enough is secured to

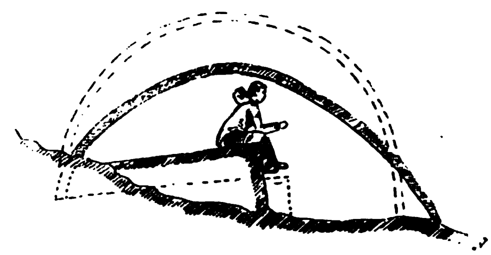


FIG. 4.

last for five or ten years, as this part of the country is almost destitute of game.

The Netschilluks' fear of their western neighbors was well illustrated by their reception of our party. As soon as they discovered us approaching, the women and children withdrew to the snow-huts, while the men formed in line with drawn bows, one arrow fixed, and the whole quiver brought around in convenient position for the use of the others. At my guide's request, I fired a gun in the air to show them that we were white men: this seemed to frighten them more than ever. At last an old woman was sent forward to meet Ikgueesik, whom I had directed to go toward them; and

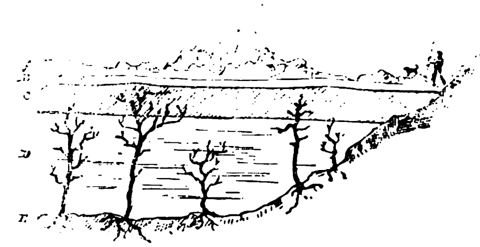


FIG. 5.

the poor old hag came forward, trembling, with a perfect bewilderment of volubility to strengthen her fast-failing courage.

[...]heir marriage relations I found but little [...]nce from those of Eskimo better known. [...]arriage contract is arranged early in life [...] parents, although Ikgueesik bought a [...]or his nearly grown brother, who was [...]f my party, for the consideration of a [...]'s jack-knife.

[...]ir pugilistic encounters generally take [...]between the 'best men' of different vil[...] and especially of different tribes, so that [...] Eskimo were promptly challenged; but [...] feather weights, compared with these [...], I interfered. Their fights are managed [...]hat in this way: one of the combatants, [...] or standing, leans forward with both [...] or elbows resting on his knees, when his [...]ent, with clinched fist, deals him such a [...]n the side of the head as he may see fit, [...]rst stroke being usually comparatively [...] No. 2 then takes his turn in leaning [...]d, and No. 1 deals him a blow, generally [...] heavier than that he has just received. [...]peration goes on until one or the other [...]er knocked senseless, or rendered help[...]om sheer exhaustion.

[...]ther danger threatening the natives of [...]rty was no less than the undertaking to [...]inate one of them, or possibly a white [...] should circumstances favor. Family [...] are not unfrequent; and, when a death [...], every male relative of the murdered [...]eels bound to avenge the death by killing [...]man of the offending tribe, the murderer [...]ne near relative being preferable. This [...]ance may be postponed almost indefinite[...]d friendly social relations maintained; [...]low as it is, it is sure to come, sooner [...]r.

[...]ave known one of these murderers to [...] take up his residence among his ene[...]and to all intents and purposes be as one [...]m. Among the Netschilluks at the last [...] we visited was a powerfully built speci[...]f his tribe, Toolooah by name. Many [...] before, — so many that he could not [...] them on his fingers, and therefore could [...]ell how many, — a relative of his had [...] a victim at the hands of an Iwillik, and [...]ot yet been avenged. Although there [...]not an Iwillik among us, still my own [...]o felt that any of us might fall to atone [...]is ancient crime. They told me that [...]elt satisfied that many of the natives [...]watched our sledge-loading the morning [...]ft had long knives secreted in their [...]s, should they need to defend the Net[...]k Toolooah, who still persisted in his [...] of revenge, should opportunity offer. But the sight of our many and wonderful weapons frightened him into a peaceful attitude. Singularly, these feuds never swell into tribal wars.

FREDERICK SCHWATKA.

HOW THE PROBLEMS OF AMERICAN ANTHROPOLOGY PRESENT THEMSELVES TO THE ENGLISH MIND.[1]

I HAVE seldom, ladies and gentlemen, felt myself in a more difficult position than I do at this moment. Yesterday morning, when we returned from an expedition out into the far west, — an expedition which your president was to have joined, but which, to our great regret, he was obliged to give up, — I heard that at this meeting of the Anthropological society of Washington I should be called upon to make, not merely a five-minutes' speech, but a substantive address; and since that time my mind has been almost entirely full of the new things that I have been seeing and hearing in the domain of anthropology in this city. I have been seeing the working of that unexampled institution, the Bureau of ethnology, and studying the collections which, in connection with the Smithsonian institution, have been brought in from the most distant quarters of the continent; and after that, in odd moments, I have turned it over in my mind, What can I possibly say to the Anthropological society when I am called upon to face them at thirty-six hours' notice? I will not apologize: I will do the best I can.

I quite understand that Major Powell, who is a man who generally has a good reason for every thing that he does, had a good reason for desiring that an anthropologist from England should say something as to the present state of the new and growing science in England as compared with its condition in America, — for believing that some communication would be acceptable between the old country and the new, upon a subject where the inhabitants of both have so much interest in common, and can render to one another so much service in the direction of their work. And therefore I take it that I am to say before you this evening, without elaborate oratory and without even careful language, how the problems of American anthropology present themselves to the English mind.

Now, one of the things that has struck me most in America, from the anthropological point of view, is a certain element of old-fashionedness. I mean old-fashionedness in the strictest sense of the word, — an old-fashionedness which goes back to the time of the colonization of America. Since the Stuart time, though America, on the whole, has become a country of most rapid progress in development as compared with other districts of the world, there has prevailed in certain parts of it a conservatism of even an intense character. In districts of the older states, away from the centres of population, things that are old-fashioned to modern Europe have held their

[1] A lecture delivered by Dr. EDWARD B. TYLOR before the Anthropological society of Washington, Oct. 11, 1884.

own with a tenacity somewhat surprising. If I ever become possessed of a spinning-wheel, an article of furniture now scarce in England, I can hardly get a specimen better than in Pennsylvania, where 'my great-grandmother's spinning-wheel' is shown — standing, perhaps in the lumber-room, perhaps in an ornamental place in the drawing-room — oftener than in any other country that I ever visited.

In another respect Pennsylvania has shown itself to me fruitful of old-fashioned products. I was brought up among the Quakers, — like so many, I dare say, who are present; for the number of times in the week, or even in the day, in which it occurs that those whom one meets prove to be at least of Quaker descent, represents a proportion which must be highly pleasant to the Quaker mind. In the history of the Society of the Friends, there has recently come out a fact unknown, especially to the Friends themselves. Their opinion has always been that they came into existence in the neighborhood of 1600, by spontaneous generation, in an outburst of spiritual development in England. It has now been shown, especially by the researches of Robert Barclay (not the old controversialist, but a modern historian), that the Quakers were by no means the absolutely independent creation that they and others had supposed them to be; that they were derived from earlier existing denominations by a process which is strictly that of development. Their especial ancestors, so to speak, were a division of the early Dutch sect known as Mennonites. The Friends have undergone much modification as to theological doctrine; but some of their most pronounced characteristics, such as the objection to war and oaths, and even details of costume, and the silent grace before meals, remain as proofs of Mennonite derivation. To find the Mennonites least changed from their original condition is now less easy in their old homes in Europe than in their adopted homes in the United States and Canada, whither they have migrated from time to time, up till quite recently, in order to avoid being compelled to serve as soldiers. They have long been a large and prosperous body back in Pennsylvania. I went to see them; and they are a very striking instance of permanency of institutions, where an institution or a state of society can get into prosperous conditions in a secluded place, cut off from easy access of the world. Among them are those who dissent from modern alteration and changes by a fixed and unalterable resolution that they will not wear buttons, but will fasten their coats with hooks and eyes, as their forefathers did. And in this way they show with what tenacity custom holds when it has become matter of scruple and religious sanction. Others have conformed more and more to the world; and most of those whom I have seen were gradually conforming in their dress and habits, and showing symptoms of melting into the general population. But, in the mean time, America does offer the spectacle of a phase of religious life, which, though dwindling away in the old-world region where it arose, is quite well preserved in this newer country, for the edification of students of culture. These people, who show such plain traces of connection with the historical Anabaptists that they may be taken as their living representatives, still commemorate in their hymns their martyrs who fell in Switzerland for the Anabaptist faith. There was given me only a few days ago a copy of an old scarce hymn-book, anterior to 1600, but still in use, in which is a hymn commemorative of the martyr Haslibach, beheaded for refusing to conform to the state religion, whose head laughed when it was cut off.

Now, to find thus, in a secluded district, an old state of society resisting for a time the modifying influences which have already changed the world around, is no exceptional state of things. It shows the very processes of resisted but eventually prevailing alteration which anthropologists have to study over larger regions of space and time in the general development of the world. In visiting my Mennonite friends in Pennsylvania, I sometimes noticed, that, while they thought it nothing strange that I should come to study them and their history, yet when I was asked where I was going next, and confessed with some modesty that I was going with Major Powell to the far west to see the Zuñis, this confession on my part was received with a look of amazement, not quite unmingled with kindly reproof: it seemed so strange to my friends that any person travelling about of his own will should deliberately go to look at Indians. I found it hard to refrain from pointing out, that, after all, there is a community of purpose between studies of the course of civilization, whether carried out among the colonists of Pennsylvania or among the Indians of New Mexico. Investigation of the lower races is made more obscure and difficult through the absence of the guidance of written history, but the principle is the same.

A glance at the tribes whom Professor Moseley and I have seen in the far west during the last few weeks has shown one or two results which may be worth stating; and one, merely parenthetical, I think I must take leave to mention, though it lies outside the main current of my subject.

Our look at North-American Indians, of whom it has been my lot to write a good deal upon second-hand evidence, had, I am glad to say, a very encouraging effect; because it showed, that on the whole, much as the writings of old travellers and missionaries have to be criticised, yet if, when carefully compared, they agree in a statement, personal inspection will generally verify that statement. One result of our visit has been, not a diminution, but an increase, of the confidence with which both of us in future will receive the statements of travellers among the Indians, allowing for their often being based upon superficial observation. So long as we confine ourselves to things which the traveller says he saw and heard, we are, I believe, upon very solid ground.

To turn to our actual experiences. The things that one sees among the Indian tribes who have not become so 'white' as the Algonkins and the Iroquois, but who present a more genuine picture of old American life, do often, and in the most vivid way,

present traces of the same phenomena with which one is so familiar in old-world life. Imagine us sitting in a house just inside California, engaged in what appeared to be a fruitless endeavor on the part of Professor Moseley to obtain a lock of hair of a Mojave to add to his collection. The man objected utterly. He shook his head. When pressed, he gesticulated and talked. No: if he gave up that bit of hair, he would become deaf, dumb, grow mad; and, when the medicine-man came to drive away the malady, it would be of no use, he would have to die. Now, all this represents a perfectly old-world group of ideas. If you tried to get a lock of hair in Italy or Spain, you might be met with precisely the same resistance; and you would find that the reason would be absolutely the same as that which the Mojave expressed, — that by means of that lock of hair one can be bewitched, the consequence being disease. And within the civilized world the old philosophy which accounts for disease in general as the intrusion of a malignant spirit still largely remains; and the exorcising such a demon is practised by white men as a religious rite, even including the act of exsufflating it, or blowing it away, which our Mojave Indian illustrated by the gesture of blowing away an imaginary spirit, and which is well known as forming a part of the religious rites of both the Greek and Roman church. How is it that such correspondence with old-world ceremonies should be found among a tribe like the Mojaves, apparently Mongolian people, though separated geographically from the Mongolians of Asia? Why does the civilization, the general state of culture, of the world, present throughout its whole range, in time and space, phenomena so wonderfully similar and uniform? This question is easy to ask; but it is the question, which, in few words, presents the problem which, to all anthropologists who occupy themselves with the history of culture, is a problem full of the most extreme difficulty, upon which they will have for years to work, collecting and classifying facts, in the hope that at some time the lucky touch will be made which will disclose the answer. At present there is none of an absolute character. There is no day in my life, when I am able to occupy myself with anthropological work, in which my mind does not swing like a pendulum between the two great possible answers to this question. Have the descendants of a small group of mankind gone on teaching their children the same set of ideas, carrying them on from generation to generation, from age to age, so that when they are found in distant regions, among tribes which have become different even in bodily formation, they represent the long-inherited traditions of a common ancestry? Or is it that all over the world, man, being substantially similar in mind, has again and again, under similar circumstances of life, developed similar groups of ideas and customs? I cannot, I think, use the opportunity of standing at this table more profitably than by insisting, in the strongest manner which I can find words to express, on the fundamental importance of directing attention to this great problem, the solution of which will alone bring the study of civilization into its full development as a science.

Let me put before you two or three cases, from examples which have been brought under my notice within the last few days, as illustrating the ways in which this problem comes before us in all its difficulty.

This morning, being in the museum with Major Powell, Professor Moseley, and Mr. Holmes, looking at the products of Indian life in the far west, my attention was called to certain curious instruments hanging together in a case in which musical instruments are contained. These consisted simply of flat, oblong, or oval pieces of wood, fastened at the end to a thong, so as to be whirled round and round, causing a whirring or roaring noise. The instruments in question came, one from the Ute Indians, and one from the Zuñis. Now, if an Australian, finding himself inspecting the National museum, happened to stand in front of the case in question, he would stop with feelings not only of surprise, but probably of horror; for this is an instrument which to him represents, more intensely than any thing else, a sense of mystery attached to his own most important religious ceremonies, especially those of the initiation of youths to the privileges of manhood, where an instrument quite similar in nature is used for the purpose of warning off women and children. If this Australian were from the south, near Bass Strait, his native law is, that, if any woman sees these instruments, she ought immediately to be put to death; and the illustration which he would give is, that, in old times, Tasmania and Australia formed one continent, but that one unlucky day it so happened that certain boys found one of these instruments hidden in the bush, and showed it to their mothers, whereupon the sea burst up through the land in a deluge, which never entirely subsided, but still remains to separate Van Dieman's Land from Australia. And, even if a Caffre from South Africa were to visit the collection, his attention would be drawn to the same instruments, and he would be able to tell that in his country they were used for the purpose of making loud sounds, and warning the women from the ceremonies attending the initiation of boys. How different the races and languages of Australia and Africa! yet we have the same use cropping out in connection with the same instrument; and, to complete its history, it must be added that there are passages of Greek literature which show pretty plainly that an instrument quite similar was used in the mysteries of Bacchus. The last point is, that it is a toy well known to country-people, both in Germany and in England. Its English name is the 'bull-roarer;' and, when the children play with it in country villages, it is hardly possible (as I know by experience) to distinguish its sound from the bellowing of an angry bull.

In endeavoring to ascertain whether the occurrence of the 'bull-roarer' in so many regions is to be explained by historical connection, or by independent development, we have to take into consideration, first, that it is an apparatus so simple as possibly to have been found out many times; next,

that its power of emitting a sound audible at a great distance would suggest to Australians and Caffres alike its usefulness at religious ceremonies from which it was desired to exclude certain persons. Then we are led to another argument, into which I will not enter now, as to the question why women are excluded in the most rigid manner from certain ceremonies. But in any event, if we work it out as a mere question of probabilities, the hypothesis of repeated reinvention under like circumstances can hold its own against the hypothesis of historical connection: but which explanation is the true one, or whether both are partly true, I have no sufficient means to decide. Such questions as these being around us in every direction, there are only two or three ways known to me in which at present students can attack them with any reasonable prospect of success. May I briefly try to state, not so much by precept as by example, what the working of those methods is by which it is possible, at any rate, to make some encroachments upon the great unsolved problem of anthropology?

One of the ways in which it is possible to deal with such a group of facts may be called the argument from outlandishness. When a circumstance is so uncommon as to excite surprise, and to lead one to think with wonder why it should have come into existence, and when that thing appears in two different districts, we have more ground for saying that there is a certain historical connection between the two cases of its appearance than in the comparison of more commonplace matters. Only this morning a case in point was brought rather strikingly under my notice: not that the facts were unknown, for we have been studying them for days past [illegible]. The Indians of the [illegible] and especially [illegible] as we know [illegible] M[illegible]

[illegible]

it came down from the northern tribes and was adopted by the southern, or whether both had it from a common source, — that, at any rate, there is some ground, upon the score of mere outlandishness, for supposing that such an idea could not occur without there being some educational connection between the two groups of tribes possessing it, and who could hardly have taken it by independent development?

To mention an instance of the opposite kind: I bought a few days ago, among the Mojaves, a singular article of dress, — a native woman's girdle, with its long fringe of twisted bark. This, or rather two of these put on so as to form one complete skirt, used to be her only garment; and it is still worn from old custom, but now covered by a petticoat of cotton, generally made of several pocket-handkerchiefs in the piece, bought from the traders. Under these circumstances, it has become useless as a garment, only serving as what I understand is called in the civilized world a 'dress-improver;' the effect of which, indeed, the Mojave women perfectly understand, and avail themselves of in the most comic manner. Suppose, now, that we had no record of how this fantastic fashion came into use among them: it has only to be compared with the actual wearing of bark garments in Further Asia and the Pacific Islands in order to tell its own history, — that it is a remnant of the phase of culture where bark is the ordinary material for clothing. But the anthropologist could not be justified in arguing from this bark-wearing that the ancestors of the Mojaves had learned it from Asiatics. Independent development, acting not only where men's minds, but their circumstances, are similar, must be credited with much of the similarity of customs. It is curious that the best illustrations of this [illegible] come from customs which are alike in [illegible] in two places, and [illegible] may be accounted for, [illegible] by emigration from one place [illegible]. We find it much easier to deal with [illegible] corresponding workings of the human mind, but also different enough [illegible]. Only this morning I met with an excellent instance of this. Dr. Yarrow, [illegible] on the subject of funeral rites, de[illegible] of the [illegible] of disposing of [illegible] they fear and hated by putting [illegible] in streams. After much inquiry, [illegible] of this proceeding was to [illegible] the survivors. [illegible] a passage in an old writer on West [illegible] dead, his [illegible] the river in [illegible] lang- [illegible] most [illegible] she was [illegible] that [illegible] different [illegible] for

hoctaw dead to pass the dreadful river. In such pondences of principle we trace, more clearly in mere repetitions of a custom or belief, the unity of human intellect.

I must not turn these remarks into what, ordinary circumstances, would be a lecture. e been compelled to address myself, not so to the statement in broad terms of general ples, as to points of detail of this kind, because lmost impossible, in the present state of anthro-, to work by abstract terms; and the best way cidating a working-principle is to discuss some case. There are now two or three practical on which I may be allowed to say a few words. principle of development in civilization, which ents one side of the great problem I have been ing of, is now beginning to receive especial cul-on in England. While most museums have been rk, simply collecting objects and implements, useum of Gen. Pitt-Rivers, now about to be re-l from London to Oxford, is entirely devoted to orking-out of the development theory on a scale attempted hitherto. In this museum are col- specimens of weapons and implements, so as ertain by what steps they may be considered to arisen among mankind, and to arrange them in cutive series. Development, however, is not s progress, but may work itself out into lines generation. There are certain states of society ich the going-down of arts and sciences is as able a state of things as progress is in the more ate regions in which we live. Anthropologists atch with the greatest interest what effect this m of development will have upon their science. Pitt-Rivers was led into the formation of the kable collection in question in an interesting er. He did not begin life either as an evolu-t or as an anthropologist. He was a soldier. usiness, at a particular time of his life, was to on a committee on small-arms, appointed to re- the armament of the British army, which at ime was to a great extent only provided with nost untruthful of percussion-muskets. He found that a rifle was an instrument of gradual h; for the new rifles which it was his duty to t had not come into existence at once and in-dently. When he came to look carefully into story of his subject, it appeared that some one nproved the lock, then some one the rifling, and others had made further improvements; and rocess had gone on, until at last there came xistence a gun, which, thus perfected, was able d its own in a permanent form. He collected termediate stages through which a good rifle out of a bad one; and the idea began to cross ind that the course of change which happened s was very much what ordinarily happens with things. So he set about collecting, and filled use from the cellar to the attic, hanging on his series of all kinds of weapons and other instru- which seemed to him to form links in a great of development. The principle that thus be- visible to him in weapon-development is not less true through the whole range of civilization; and we shall soon be able to show to every anthropologist who visits Oxford the results of that attempt. And when the development theory is seen in that way, explaining the nature and origin of our actual arts and customs and ideas, and their gradual growth from ruder and earlier states of culture, then anthropology will come before the public mind as a new means of practical instruction in life.

Speaking of this aspect of anthropology leads me to say a word on another hardly less important. On my first visit to this country, nearly thirty years ago, I made a journey in Mexico with the late Henry Christy, a man who impressed his personality very deeply on the science of man. He was led into this subject by his connection with Dr. Hodgkin; the two being at first interested, from the philanthropist's point of view, in the preservation of the less favored races of man, and taking part in a society for this purpose, known as the Aborigines' protection society. The observation of the indigenous tribes for philanthropic reasons brought the fact into view that such peoples of low culture were in themselves of the highest interest as illustrating the whole problem of stages of civilization; and this brought about the establishment of the Ethnological society in England, Henry Christy's connection with which originated his plan of forming an ethnological museum. The foundations of the now celebrated Christy collection were laid on our Mexican journey; and I was witness to his extraordinary power of knowing, untaught, what it was the business of an anthropologist to collect, and what to leave uncollected; how very useless for anthropologic purposes mere curiosities are, and how priceless are every-day things. The two principles which tend most to the successful work of anthropology — the systematic collection of the products of each stage of civilization, and the arrangement of their sequence in development — are thus the leading motives of our two great anthropological museums.

To my mind, one of the most remarkable things I have seen in this country is the working of the Bureau of ethnology as part of the general working of the government department to which it belongs. It is not for me, on this occasion, to describe the working of the Smithsonian institution, with its research and publication extending almost through the whole realm of science; nor to speak of the services of that eminent investigator and organizer, Prof. Spencer F. Baird. It is the department occupied with the science of man of which I have experience; and I do not think that anywhere else in the world such an official body of skilled anthropologists, each knowing his own special work, and devoted to it, can be paralleled. The Bureau of ethnology is at present devoting itself especially to the working-up of the United States, and to the American continent in general, but not neglecting other parts of the world. And I must say that I have seen with the utmost interest the manner in which the central organism of the Bureau of ethnology is performing the functions of an amasser and collector of all that is worth

knowing; how Major Powell is not only a great explorer and worker himself, but has the art of infusing his energy and enthusiastic spirit through the branches of an institution which stands almost alone, being, on the one hand, an institution doing the work of a scientific society, and, on the other hand, an institution doing that work with the power and leverage of a government department. If we talked of working a government institution in England for the progress of anthropology in the way in which it is being done here, we should be met with — silence, or a civil answer, but with no practical result; and any one venturing to make the suggestion might run the risk of being classed with that large body described here as 'cranks.' The only way in which the question can be settled, how far a government may take up scientific research as a part of its legitimate functions, is by practical experiment; and somehow or other your president is engaged in getting that experiment tried, with an obvious success, which may have a great effect. If in future a proposition to ask for more government aid for anthropology is met with a reply that such ideas are fanatical, and that such schemes will produce no good results, we have a very good rejoinder in Washington. The energy with which the Bureau of ethnology works throughout its distant ramifications has been a matter of great interest. It is something like what one used to hear of the organization of the Jesuits, with their central authority in a room in a Roman palace, whence directions were sent out which there was some agent in every country town ready to carry out with skill and zeal. For instance: it was interesting at Zuñi to follow the way in which Col. and Mrs. Stevenson were working the pueblo, trading for specimens, and bringing together all that was most valuable and interesting in tracing the history of that remarkable people. Both managed to identify themselves with the Indian life. And one thing I particularly noticed was this, that to get at the confidence of a tribe, the man of the house, though he can do a great deal, cannot do all. If his wife sympathizes with his work, and is able to do it, really half of the work of investigation seems to me to fall to her, so much is to be learned through the women of the tribe, which the men will not readily disclose. The experience seemed to me a lesson to anthropologists not to sound the 'bull-roarer,' and warn the ladies off from their proceedings, but rather to avail themselves thankfully of their help.

Only one word more, and I will close. Years ago, when I first knew the position occupied by anthropology, this position was far inferior to that which it now holds. It was deemed, indeed, curious and amusing; and travellers had even, in an informal way, shown human nature as displayed among out-of-the-way tribes to be an instructive study. But one of the last things thought of in the early days of anthropology, was that it should be of any practical use. The effect of a few years' work all over the world shows that it is not only to be an interesting theoretical science, but that it is to be an agent in altering the actual state of arts and beliefs and institutions in the world. For instance: look at the arguments on communism in the tenure of land in the hands of a writer who thinks how good it would be if every man always had his share of the land. The ideas and mental workings of such a philosopher are quite different from those of an anthropologist, who knows land-communism as an old and still existing institution of the world, and can see exactly how, after the experience of ages, its disadvantages have been found to outweigh its advantages, so that it tends to fall out of use. In any new legislation on land, the information thus to be given by anthropology must take its place as an important factor.

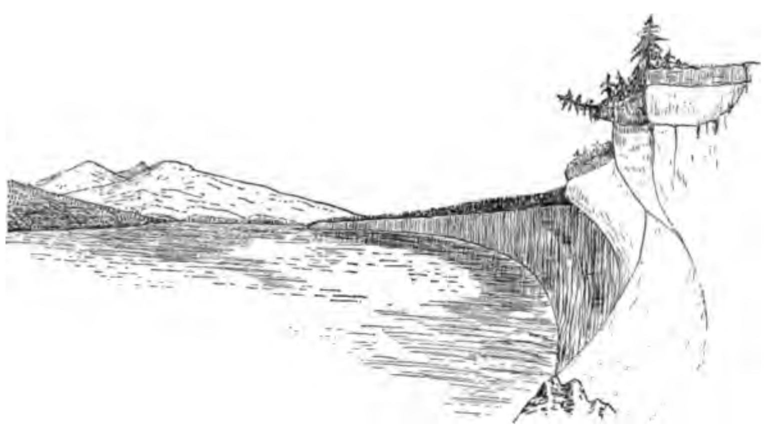
Again: when long ago I began to collect materials about old customs, nothing was farther from my thoughts than the idea that they would be useful. By and by it did become visible, that to show that a custom or institution which belonged to an early state of civilization had lasted on by mere conservatism into a newer civilization, to which it is unsuited, would somehow affect the public mind as to the question whether this custom or institution should be kept up, or done away with. Nothing has for months past given me more unfeigned delight than when I saw in the *Times* newspaper the corporation of the city of London spoken of as a 'survival.' You have institutions even here which have outlived their original place and purpose; and indeed it is evident, that, when the course of civilization is thoroughly worked out from beginning to end, the description of it from beginning to end will have a very practical effect upon the domain of practical politics. Politicians have, it is true, little idea of this as yet. But it already imposes upon bodies like this anthropological society a burden of responsibility which was not at first thought of. We may hope, however, that, under such leaders as we have here, the science of anthropology will be worked purely for its own sake: for, the moment that anthropologists take to cultivating their science as a party-weapon in politics and religion, this will vitiate their reasonings and arguments, and spoil the scientific character of their work. I have seen in England bad results follow from a premature attempt to work anthropology on such controversial lines, and can say that such an attempt is not only in the long-run harmful to the effect of anthropology in the world, but disastrous to its immediate position. My recommendation to students is to go right forward, like a horse in blinkers, neither looking to the right hand nor to the left. Let us do our own work with a simple intention to find out what the principles and courses of events have been in the world, to collect all the facts, to work out all the inferences, to reduce the whole into a science; and then let practical life take it and make the best it can of it. In this way the science of man, accepted as an arbiter, not by a party only, but by the public judgment, will have soonest and most permanently its due effect on the habits and laws and thoughts of mankind.

I am afraid I have not used well, under such short and difficult conditions, the opportunity which you have done me the great pleasure and honor of giving

I have tried, as I said I would, to put mplest way before you some considerations pear to me as of present importance in our both in the old world and in the new, and you in the heartiest way possible for the ity you have given me to do this.

RATION OF THE KOWAK RIVER.

ıve been favored by Major E. W. Clark, he Revenue marine bureau, with the follow- act of explorations on the Kowak or Kuak Alaska, made during the season of 1884 by rom the U. S. steamer Corwin, Capt. Healy. y comprised Lieut. J. C. Cantwell, com- assisted by Second-Assistant Engineer S. ıegan, a quartermaster, fireman, miner, and r, and was furnished with two small boats Corwin's steam-launch. They left the Cor- ape Krusenstern, July 8, and the following ntered Hotham Inlet by a practicable chan- r five fathoms deep, which enters the inlet ts eastern point or headland. The eastern ıern shores of the inlet are composed of clay ut two hundred feet high, backed by rolling The opposite shore, however, was low and with many lagoons, the native guide stating was the Kowak delta, which has fifteen ınd extends some fifty miles inland. The ıre at this time averaged 80° or 90° F. dur- ay. At seven o'clock on the 10th of July a s seen in the lowland of the delta, where ɜak ahead and a high bluff point on the hore form a range for the channel entering The channel is about two hundred yards h two and a half fathoms least water at the party entered. The banks are low and vith a dense growth of willow and birch, ɔred myriads of mosquitoes. At ten A.M. a collection of Innuit huts was seen, ten- ɔnly one family at that date. The banks of the river, hitherto uniformly low, began to be more elevated, and the current increased to three miles per hour. The course of the river was extremely tortuous. Another village was seen on the left bank, on a high black bluff, at four P.M. The depth of the river increased to five fathoms: its width varied, being from half to three-quarters of a mile. Many offshoots of the main stream were noticed, all extending to the northward and westward. The following day a good growth of pine, birch, and willow adorned the banks, which had previously shown only shrubbery. At half-past eight A.M. a large westerly arm was passed, which, according to the native guide, was the last arm of the delta, and flowed into the western part of Hotham Inlet. At noon the party obtained observations, placing them in latitude 68° 45′.3, and west longitude 161° 46′. At half-past two P.M. a series of ice-cliffs, like



ICE-CLIFFS ON KOWAK RIVER.

those of Eschscholtz Bay, was observed, composed of a solid mass of ice extending three-quarters of a mile along the left bank, covered by a thin layer of dark-colored earth, and rising to a height of a hundred and fifty feet. Trees were growing on the surface. Up to this point, and for some distance farther, not a single stone or pebble was to be seen, and the silence was frequently disturbed by the fall of large masses of the soft earthy banks undermined by the strong current. On the afternoon of the 13th a stretch of river extending about six miles in a north-easterly direction was reached, which offered a beautiful prospect. The river widened to half a mile, with low green banks, while beyond a range of rugged mountains could be seen. At the end of the six-mile reach was a succession of high bluffs, caused by the foot-hills coming down to the river, with a narrow, rocky beach, the slopes wooded with pine and juniper. There were many very fragrant wild-flowers, and the mosquitoes were the only dis- turbing element. This, which was named Highland Camp, was about eighty miles from the entrance of the river. About one P.M., on the 14th of July, the mouth of the Squirrel River of the natives was reached, coming in from the north-east. Its source

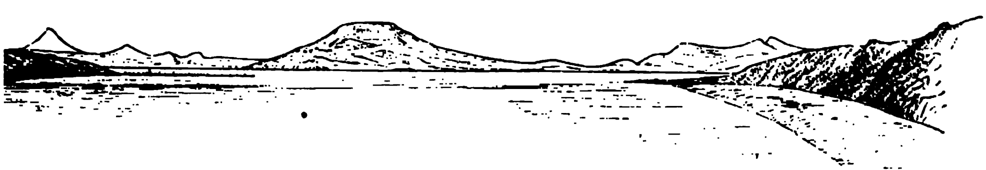
is in the mountains, one day's portage from the Nunatok, or some of its branches. Here three nearly equal waterways presented themselves, of which the middle one was chosen. The strength of the current made progress very difficult, and there were numerous bars. The right bank was high and rolling to the water side, where it formed a beach of variously colored limestone pebbles. Large masses of metamorphic rock cropped out among the dense growth of forest which lined the shore. On the left bank the land was low, being an island some ten miles long, whose upper end was reached about six P.M. On the following morning the river widened, the current became less, and the stream less crooked, and it was apparent that the party had passed the region of the mountains through which the river cuts its way. These mountains beyond the right bank rise over three thousand feet, heavily timbered at their bases, and trend nearly as the river runs. In the afternoon a large coal-vein was discovered in a bluff on the river-bank, and was extremely welcome for use in the steam-launch, though that on the surface had been weathered so as to partly impair its good quality.

This and the following day were rainy: so no observation could be had. The thermometer stood at about 90° F. At half-past six a deserted village was reached. The width of the river was from five hundred to nine hundred yards, and the depth of the channel from twelve to thirty feet. The following day another deposit of coal in a stratum of fine white clay suitable for pottery was found. This coal, however, did not burn well, probably on account of the admixture of clay. Later in the day the first rapids were reached, and passed with some difficulty; and in the evening the party halted at a fishing-village, where the natives, who were very honest and friendly, were preparing their nets for the expected run of salmon. As progress was made, the current became extremely strong, numerous rocks were found to exist alongshore, and it required much care to keep the launch from being thrown upon them by the force of the stream. Several villages and fishing-stations were passed, and small ripples or rapids became more numerous, so that the lighter boats easily outstripped the launch. On the 21st, having nearly reached the Jade Mountain, it was determined to divide the party, let the engineer and miner explore in the vicinity, while the launch was taken to a convenient spot for laying her up by Lieut. Cantwell, who would then rejoin them. The launch was left at a fishing-village, whose inhabitants informed them that the channel of the river above soon became obstructed by rocks, and ran in a sort of cañon, so that the natives do not attempt to navigate it. It divides into two branches, one of which takes its rise in a large lake (supposed to be twenty-five miles long), while the other rises farther to the eastward, near the head waters of the Koyukuk River, which enters the Yukon just above Nulato. The natives use birch canoes in this region. The river rose one foot during the night of the 22d; and the Innuit stated that the water was very high, but later, with dry weather, would fall, so that all the river-bed would be dry except the channel. Lieut. Cantwell, after repairing the furnace of the launch with the native fire-clay, left her to rejoin McLenegan and Miller with a party of Innuit. They were reached on the 24th, much exhausted by their trip, their boots worn out, pestered to an incredible degree by mosquitoes, but bringing some of the native jade and other minerals. They were sent to recuperate at the station where the launch had been left, while the others pushed on, and at noon reached a part of the river where it takes a sudden bend to the south-east, the country being low and rolling, backed by mountains on both sides. The Jade Mountain could be readily distinguished from the other peaks by its greenish color. The depth of water did not diminish. At half-past four P.M. a remarkable clay bluff, three-quarters of a mile long and a hundred and fifty feet high, was reached on the left bank of the river. Quantities of mammoth tusks were observed in this clay and its *débris* where undermined by the stream. The river now becomes very tortuous, with many islands, and tundra extending to the mountains. The soil is clayey, with a thick layer of black mould. In winter the natives, who at this time were fishing on the lower Kowak, ascend to the region of its head waters, and travel to trade with the Yukon Indians, *viâ* the Koyukuk River, or go still farther to the north-east to the range of the high Yukon Mountains, where moose and mountain sheep are found in great numbers. It was reported that on a clear day the sea (or a large lake) could be seen from these mountains in one direction. On the other side of the Yukon range is a river (doubtless the Colville) by which the sea can be reached in five days. On the 26th of July a point was reached where the river divides into two parts, the south-eastern of which was followed, on account of its more direct course, to a point where the Umakalükta River comes in from the southward. This was narrow and crooked, soon diminishing to a mere torrent. Trees two feet in diameter, and very rank shrubbery, were observed on its banks. It was ascended to a village about twenty miles above its mouth, where the explorers were kindly welcomed by the inhabitants, some of whom had never seen a white man before. Boats could not be obtained here to replace the water-soaked skin-boat of the party; but they were told that they could from this place make a portage across to the Kowak, which they would reach from twenty-five to thirty miles above the point where the Umakalükta joins it. This was determined upon, and the party camped at the village, enjoying some delicious fresh salmon.

The following day the portage was made over a hill to a small lake, then over tundra to a large lake which took four hours to cross, and then through a swamp to the Kowak again. For reasons connected with the supply of provisions and the worn state of the skin boat upon which the party depended for transportation, it was decided to return to the launch. It was supposed that there were, by native reckoning, about twelve days' farther navigation to the falls.

›rminated the navigable part of the river, ould now diminish in depth with every day eather. From a hill near the camp, the river seen, winding along the foot of the moun- l off into level country beyond, while in the ınce snowy peaks were seen, from which ·es reported that the other peaks in which the takes its source could be seen on a clear seven A.M., July 29, the party started down , descending with great velocity on the swift The mouth of the Notmoktowak or 'Pack' hich drains the country between the Nunatok ›vak, was examined, and the boat passed several sloughs not observed in coming up. t leaked and needed repairs: so on the 30th antwell left it to be mended, and started for Mountain, twelve miles away, on foot. The ·efused to accompany him, as the shaman de- ·il would come to any one who visited the n. The tramp was fatiguing; but a torrent ·hed which separates the mountain from a ɡged peak of the same range. Large quanti- ıe green stone were found in the bed of the but the mountain itself seemed actually to be composed of it, and the sides of the cliffs e polished glass for smoothness where they n subjected to pressure or wear. About a pounds of the mineral were collected; and, short nap, the party returned to the river, hey reached, almost exhausted by the heat, travelling, and the torture of sand-flies and oes. On the 2d of August the party started › meet the launch, whose boilers were so at she could not with safety attempt much ırd steaming against the current. Observa- r position and declination were obtained at points; and on the 6th of August, at two A.M., y reached Highland Camp, where sundry arti- lected on the up-trip were taken on board. 'ollowing day the party camped on the shores ıam Inlet. The distance travelled up the ıcluding all tortuosities, was estimated at ındred and seventy miles.

emainder of their stay was devoted to the ion of Hotham Inlet and Selawik Lake, and ›iated rivers and lakes, during which some ly valuable corrections to the charts were Selawik Lake is practically an extension a narrow passage of Hotham Inlet. The outh of the Kowak River empties into the in- › to the entrance of the lake, which on the de is marked by a sand-spit projecting far out e shore, forming a convenient boat harbor. The lake along its south shore is not very deep, and shoals off very gradually, so as to make landing difficult. The country is high, rolling tundra, forming a bluff bank behind the beach, covered with a thick growth of shrubbery. At intervals long spits extend far out from the shore, forming many small harbors or bays. The eastern end of the lake, where the shore trends to the north-west, is low and swampy, and the water very shoal, with a sort of bar parallel with the beach two hundred yards off. Here were myriads of water-fowl. A river comes in from the eastward about seventy-five yards wide, with from twelve to eighteen feet of water. This flows from a lovely little lake about five miles in diameter, almost entirely surrounded by mountains. A narrow creek enters the opposite side of the lake, and, ascending this, the large lake, Imogarik-cho-it, or Little Sea, of the natives is reached. The stream connecting this with Selawik Lake is called Kiaktuk or Fox River. The mountains visible from Selawik Lake border the eastern shore of Imogarik Lake, and extend nearly round it; but the northerly shore is quite low and marshy. Another branch, called the Igaiak River, connects Imogarik Lake and Selawik River about twenty-five miles from the mouth of the latter, by which Selawik Lake could be reached in two days. This was taken, and the junction of the Selawik and Igaiak rivers reached on the morning of Aug. 14. The banks of the Selawik differ little from those of the Kowak, except that the undergrowth is heavier. The width of the river varies from six hundred to a thousand yards, and in some places expands into bays a mile wide. The channel showed from four to six fathoms. From the mouth of the Igaiak, the Selawik trends about six miles in a north-westerly direction, and then south and west to Selawik Lake. Many small lakes and lagoons were observed near the river, and from a hill one large sheet of water was seen which lay near the foot of the mountains, about six miles from the river. That evening Selawik Lake was reached through a large bay filled with many islands, and the party camped on a sand-spit which formed the north point of entrance to the lake. About half-way from the river to the inlet a river comes into the lake from the mountains between the latter and the valley of the Kowak. The country here is low and marshy. The work was completed Aug. 16, and the party started down Hotham Inlet, of which a reconnoissance was made on their way. The bar at the mouth of Hotham Inlet was found to have no more than six feet of water on it anywhere at low water. On the 30th of August the party rejoined the Corwin about fifteen miles westward from Cape Blossom,



ENTRANCE TO SELAWIK LAKE.

and reported for duty without serious accident or illness of any of its members.

Reports on the minerals, birds, general character of the country and its inhabitants, the fur trade, etc., from Engineer McLenegan, accompany the report to Capt. Healy, commander of the Corwin, from which the above notes are derived. The Kowak abounds in salmon, pike, and white-fish, which are dried by the natives. The white spruce is the largest and most abundant tree. The natives are all Innuit or Eskimo; and their numbers in this region are estimated at three hundred and fifty on the Nunatok, two hundred and twenty-five on the Kowak, and two hundred and fifty on the Selawik lakes and rivers. The coal-belt is about thirty miles wide, and is probably lignitic, resembling the small seam near Nulato, on the Yukon. The 'color' of gold was obtained almost everywhere, but it is doubtful if it would pay to work it. Beds of a beautifully mottled serpentine, used by the natives for ornaments, were found in the mountains near the Kowak, as well as the so-called 'jade,' used far and wide for the most costly and elegant stone implements, which is perhaps the variety of pectolite recently described by Clarke from specimens got at Point Barrow. Seventy-seven species of birds were collected, mostly of species common to the Yukon region, among which the rock ptarmigan and white-tailed godwit (L. uropygialis?) are noteworthy, as well as the great white-billed loon (C. Adamsi).

Commercially the most important result of the expedition is the indication of a route by which whalers or others, held by the ice eastward from Point Barrow, might find a comparatively available way to the settlements on the Yukon, *via* the Colville and Kowak rivers, and through the Koyukuk valley. Geographically the journey of Lieut. Cantwell is the most important of the past year in America: and its results, taken in connection with those of Lieut. Stoney, who subsequently passed over nearly the same route, will give us an approximate knowledge of a considerable area which has hitherto been almost a blank upon the best maps.

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THE CHOLERA BACILLUS.—KOCH'S REPLY TO HIS CRITICS.

The doubts that have arisen in many minds in regard to the specific nature of the cholera bacillus of Koch may be in some measure dispelled by the latter's answers to his critics in a recent number of the *Deutsche medicinische wochenschrift* (No. 45, 1884). In it he shows the differences between the
Fi cholera bacillus and that found in the mouth (*Lan-*
obta*et*, Sept. 20, 1884), and then takes up the work of
own);kler and Pryor. He shows that they have not
rapid ined pure cultures (this from specimens of their
In exam. that their bacillus is larger and thicker, more
he failed growth, and very different in 'culture-form.'
also succeeinations of three cases of 'cholera nostras,'
to find the 'comma bacillus.' Koch has
ied in producing cholera by the inoculation of one one-hundredth of a drop of a solution of a pure culture. This produced death in rabbits and guinea-pigs in from one and a half to three days, when placed in the duodenum. The appearances *post mortem* were those of the human subject in death from Asiatic cholera.

In addition to this, we have the confirmatory evidence of E. van Ermengen in a communication to the Belgian microscopical society, Oct. 26, 1884 (*Lancet*, Nov. 29, 1884). This observer found the comma bacillus in the intestinal fluids of eight autopsies and thirty-four examinations of stools. He considers that its peculiar-shaped, chain-like groups and occasional wavy filaments distinguish it completely from other bacteria. He finds that it is more or less abundant, according to the stage of the disease; and in two cases (*foudroyant*) they were present almost as in a pure culture. They disappear during reaction.

Premonitory diarrhoea was not investigated for the presence of the organism, for lack of time. In cases of algide cholera, where no bacilli were found in the stools, culture of the most minute portion produced enormous numbers of the organism within twenty-four hours. He considers that the presence of the organism is diagnostic of cholera, and that the method of microscopic examination in conjunction with cultures should be adopted in all doubtful cases. By thus settling the diagnosis early, efficient prophylaxis against the spread of the disease may be established. He found no spores, and considers their absence probably established by the want of resistance to drying of this organism. He finds precisely the same differences between the cholera bacillus and those of Lewis and of Finkler and Pryor, and exactly the same objections to the latter's work, as does Koch (*loc. cit.*). He, as well as Koch, succeeded in producing cholera by inoculation of one drop of a culture, extending over four days (this in dogs, guinea-pigs, and rabbits). The cadaveric appearances were those of cholera; and the intestinal fluids contained many comma bacilli, from which further cultures were made. He thinks that the pathogenic action of these bacteria is very likely due to some product of their growth in the material in which they are sown, and closes his communication by advising that physicians generally should be instructed in the methods of microscopic search for these organisms in order to the early determination of the existence of the disease, and all that that implies. This is a recommendation which might be made in this country, and adopted with much benefit to the community at large.

Such observations as these furnish strong evidence that the world is again indebted to Koch for his labors in the investigation of disease, and that the links connecting his cholera bacillus with cholera as its specific cause are being forged into a complete chain of evidence.

In regard to the organism itself, we have received within a day or two a slide containing masses of bacilli from a pure culture. The preparation is a very beautiful one; and its authenticity is undoubt-

much as it was put up and forwarded by Koch '. It shows all the peculiarities of shape de- by him, and most certainly bears out the asser- at it possesses distinguishing characteristics ther bacteria. In form and arrangement, it markedly from any other organism with we are acquainted, either those found in the ies or elsewhere.

SCIENCE IN MANCHESTER.

nary of science in Manchester. (In a series otes.) By R. ANGUS SMITH, Ph.D., LL.D. don, *Taylor & Francis.* 475 p. 8°.

progress of literature and science in ester, Eng., is full of interest to Ameri- It is not only that the city is full of d vigor, and that its relations to the l States are very close, but there is a f western freshness in all its undertak- Owens college is not yet forty years old; ictoria university is more recent than Hopkins; the Literary and philosophical of Manchester is younger by several than the American academy and the can philosophical society; and the Free library is the junior of the Astor library York. Manchester has grown during ntury more rapidly than Baltimore, and lth has increased at a rate which is still emarkable. Under these circumstances, ve examined with some curiosity the prepared for the hundredth year of the ry and philosophical society of Manches- 81.

ong the many honorable names com- ated in it, two are pre-eminent, — Dalton ule. The former established the science mistry on the basis of the atom: the lat- certained the mechanical equivalent of Referring to these great discoverers, nith expresses his belief that there has 'a law in the recesses of humanity which used the influence of the community to trate itself, first into the Society, and through particular members, into the of chemistry, equivalents of atoms, and onnection with mechanical force, — the edge of which must influence mankind r." Dalton's development of the atomic was preceded by other noteworthy con- ons to science, — his discovery of color- ess, his epoch-marking essays in meteor- and his elaborate inquiry on the force or; to all of which brief reference is ade.

e was a pupil of Dalton; "a follower," says Smith, "worthy of the prophet; . . . a pupil who has become the master of many learners." The relations of these two men are thus described. "The idea of units of *measure* in Dalton's mind developed itself gradually into the idea of units of *force* in the mind of Joule. . . . To say that the two are the most successful descendants of the great thinkers who have grappled with the subject of atoms for three thousand years, is but to express a simple fact; and to assert that Dalton and Joule have made the great leading discoveries on the subject is simply to follow history. From one we learn the order in which the ultimate particles of bodies move: from the other we learn the force and relation of their movements in those great phenomena, heat, electricity, and mechanical force."

There are other stars in the Manchester firmament. Among them are William Fairbairn, builder of the tubular bridge at Menai, a man of 'wonderful instinct' as an engineer; and his more scientific coadjutor, Eaton Hodgkinson. Sir John Hawkshaw, Sir Henry Roscoe, and Professor Balfour Stewart are famous among recent members of the society. The laboratory of Dr. Edward Schunck is said to be the finest private laboratory in the country. The founder of the society, Dr. Thomas Percival, a physician of great repute, who had the skill to elicit the best co-operation of other men, is commemorated by Dr. Smith as one who foreshadowed some of Darwin's views. His contemporary in the society, Charles White, Dr. John Ferriar and the three Henrys, also receive due notice; and so does Thomas Cooper, afterwards of Columbia, S.C., whose name has recently been brought to mind by allusions to it in the autobiography of Dr. Marion Sims.

The comments of Dr. Smith on the present state of the society are suggestive. First, he recognizes a disposition, on the part of the Manchester investigators, to send their papers to the Royal society of London. "It is useless to complain of this: it is a phase of national life, and it will probably grow stronger for a time, until this sub-centre becomes sufficiently brilliant to make men feel that it is an object of great ambition to become distinguished here." The writer thinks that Manchester has allowed its forces to be too much scattered. Next he pleads for enlarged quarters. The members of the society are unwilling to leave the rooms where Dalton studied, which were his home from morning until evening for the greater part of his life; but more space is demanded. Third, he answers the

criticism that the society gives 'no lectures, no *soirées*, no displays.' Fourth, he argues that original researches should be encouraged in Manchester, and that this society should inspire and aid such work. This leads him to mention the good influence of Owens college and the Victoria university. He closes the chapter with the strong assertion, which few men of science will dispute, that if Manchester, and many cities and countries besides, were obliterated from the earth, the loss would be less than it would be if the world should lose the influence which came from Dalton's atomic theory and from Joule's law of the mechanical equivalent of heat.

INDIAN SIGN-LANGUAGE.

The Indian sign-language; with brief explanatory notes of the gestures taught deaf-mutes in our institutions for their instruction, and a description of some of the peculiar laws, customs, myths, superstitions, ways of living, code of peace, and war-signals of our aborigines. By W. P. CLARK, U.S.A. Philadelphia, *Hamersley*, 1885. 443 p. 8°.

THE study of the gesture-speech of our Indians began in 1801, when Mr. William Dunbar read a paper on the subject before the American philosophical society, which was published in their Transactions. Only quite within the last decade, however, has the subject received the careful attention which it merits. In 1880 there appeared, under the auspices of the Bureau of ethnology, three works, or rather portions of the same work, from the pen of Col. Garrick Mallery, U.S.A., entitled "A collection of gesture signs and signals of the North-American Indians, with some comparisons" (distributed only to collaborators, and therefore one of the bibliographic rarities of the government press); "Introduction to the study of sign-language among the North-American Indians;" and "Sign-language among North-American Indians compared with that among other peoples and deaf-mutes." This last, which was printed in the first report of the Bureau of ethnology, is amply illustrated, and may be considered the completion of Col. Mallery's investigations in this direction. It includes a history of gesture-language in both the old and new world, its study as a phase of evolution, its prevalence in America, its relations to philology, its connection with the origin of writing and the interpretation of pictographs, and the bearings it has upon theories of syntax and etymology.

These applications are striking and instructive in a high degree, and vindicate the eminently important place which the philosophic study of gesture-speech must hereafter occupy in archeologic research. An excellent illustration of it is given by Dr. W. J. Hoffman, in an article on American pictography in the Transactions of the Anthropological society of Washington (vol. ii. 1883), where by its aid he translates in the most satisfactory manner a petroglyph from California, and an Innuit carving on ivory. Such a demonstration of the significant character of these primitive rock inscriptions and carvings was the more timely, since the distinguished ethnologist, Dr. Richard Andree, in his 'Ethnographische parallelen und vergleiche,' has condemned pretty much all these relics as the idle and meaningless amusements of savages.

Capt. Clark's work is a welcome addition to our knowledge of the subject. He speaks from long personal observation and a practical familiarity with this mode of communicating ideas. His studies began in 1876, and were continued for years, mainly within the limits of the plains or prairie tribes. As in Mallery's treatise, the words are arranged alphabetically, the signs following them, thus facilitating comparison. An advantage in Capt. Clark's presentation is, that he adds the mental conception or picture which the native forms to himself of the object or idea to be represented, thus furnishing a clearer meaning to the sign, and also enlightening the reader as to the psychology of the aboriginal thinker. His definitions are by no means confined to explaining the sign-language. He fully redeems the promise on his titlepage to describe the laws, customs, myths, and peculiarities of the tribes he names. These facts are all fresh, derived from original observation, and add a great deal to the available ethnological information of the prairie Indians.

Such material must, however, be used with caution. When (p. 10) the author infers from the myths of the Indians that there was a time, referred to in these narratives, in which the natives did not know the use of the bow and arrow, he attributes to these stories an antiquity which they by no means possess. The stemmed and barbed arrow-head was in use when the loess of the now long since dried-up Nebraska lakes was in process of formation, almost a geologic cycle ago.

In an appendix the author describes a number of signals with a blanket, a pony, or a mirror, and adds the explanation of various geographical names. It is a peculiarity that

not undertake to explain, that he nowhere […]s by name to those writers whose works […]preceded his, and which we have men[…] in the earlier paragraphs of this notice.

CASTE IN INDIA IN 1881.

[…]*of Punjáb ethnography.* By DENZIL [CHA]RLES JELF IBBETSON of her Majesty's Ben[gal] civil service. Calcutta, *Government*, 1883.

[…]*d census of 1881.* Digest of the results in [the] presidency of Bombay, including Sind. By [orde]r of government. Bombay, *Government*, […].

[…] *of the census of Bengal, 1881.* By J. A. [BOU]RDILLON of the Bengal civil service. Cal[cutt]a, *Secretariat pr.*, 1883.

[THE]SE reports treat of about 109,000,000 of […]8,000,000 people of India. The Punjáb […]23,000,000) has about 41% Hindus, […]Mahometans, 7% Sikhs. Bombay and […]16,500,000) have 73% Hindus; Bombay […]84%. Bengal (69,500,000) has 64% […]s. The chief strength of the Sikhs in […]is in the Punjáb. The preponderance […]er races and religions in the Punjáb gives […]ial field for inquiry how far caste is a […] institution.

[…] Ibbetson deems the treatment of caste […]o, including his own work, inadequate […]nsatisfactory, and he recognizes that […]dictory statements regarding the same […] may be true in different localities. He […]–

[…]popular and currently received theory of caste […]o consist of three main articles:

[…]'hat caste is an institution of the Hindu reli[gion an]d peculiar to that religion alone;

[…]'hat it consists primarily of a fourfold classifi[cation o]f people in general, under the heads of Bráh[man, K]shatriya, Vaisya, and Súdra;

[…]'hat caste is perpetual and immutable, and [has bee]n transmitted from generation to generation, [through]out the ages of Hindu history and myth, with[out the] possibility of change.

I should probably be exaggerating in the op[posite d]irection, but I think that I should still be far [from t]he truth, if, in opposition to the popular con[ception] thus defined, I were to say, —

[…]'hat caste is a social far more than a religious [instituti]on; that it has no necessary connection what[ever wit]h the Hindu religion, further than that under [that reli]gion certain ideas and customs common to all [primitiv]e nations have been developed and perpetu[ated in a]n unusual degree; and that conversion from [Hinduis]m to Islám has not necessarily the slightest [effect up]on caste:

[…]'hat there are Bráhmans who are looked upon [as prie]sts by those who, under the fourfold classifi[cation, w]ould be classed as Súdras; that there is no [such thi]ng as a Vaisya now existing; that it is very [doubtfu]l indeed whether there is such a thing as a Kshatriya, and, if there is, no two people are agreed as to where we shall look for him; and that Súdra has no present signification save as a convenient term of abuse to apply to somebody else whom you consider lower than yourself; while the number of castes which can be classed under any one or under no one of the four heads, according as private opinion may vary, is almost innumerable:

3°. That nothing can be more variable or difficult to define than caste; and that the fact that a generation is descended from ancestors of any given caste, creates a presumption, and nothing more, that that generation also is of the same caste, — a presumption liable to be defeated by an infinite variety of circumstances.

Mr. Ibbetson gives 275 pages to the consideration of religions, races, castes, and tribes of the people of the Punjáb, and justice to his work is hardly possible in a brief space. Summing up as to evolution of caste, he says: —

Thus, if my theory be correct, we have the following steps by which caste has been evolved in the Punjáb:

1°. The tribal division common to all primitive societies;

2°. The guilds based upon hereditary occupation common to the middle life of all communities;

3°. The exaltation of the priestly office to a degree unexampled in other countries;

4°. The exaltation of Levitical blood by a special insistence upon the necessarily hereditary nature of occupation;

5°. The preservation and support of this principle by the elaboration from the theories of the Hindu creed or cosmogony of a purely artificial set of rules, regulating marriage and intermarriage, declaring certain occupations and foods to be impure and polluting, and prescribing the conditions and degree of social intercourse permitted between the several castes. Add to these the pride of social rank and the pride of blood, which are natural to man, . . . and it is hardly to be wondered at that caste should have assumed the rigidity which distinguishes it in India.

He holds that caste in the Punjáb is primarily based on occupation, and, with the masses owning and cultivating land, upon political position, which brings in the tribal element. The trades-guild type of caste, found chiefly in the large cities, owes its existence largely to the prevalence of Mahometan ideas. "The people are bound by social and tribal custom far more than by any rules of religion. . . . The difference [between Hindu and Mussulman] is national rather than religious." In some cases Mahometanism has here strengthened the caste bonds of its adherents. The four castes leading in number in the Punjáb are Jats, probably of Indo-Scythian stock (agriculturists and ploughmen); Rajputs, 'Sons of Rajas' (largely land-owners, preferably pastoral, and avoiding personal ploughing); Brahmans, priestly and Levitical; Chuhras; the scavengers; numbering respectively about 4,500,000, 1,500,000, 1,000,000, and 1,000,000.

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In Sind little detail was observed in abstracting information respecting caste. In the Bombay presidency 84% of the people are Hindus. Caste is not discussed elaborately in the Digest of the census, but incidentally the views of Mr. Ibbetson as to the close relation of occupation, tribe, religion, and caste, are sustained by the unnamed official who prepared the Digest. Among the 200 pages of tables, one table shows 'Class and name of caste,' 'Hereditary occupation,' ratios occupied in certain general pursuits, and, under 'Remarks,' more definitely the numbers actually occupied in pursuits not hereditary. The largest caste is the Kunbi, or cultivators, of the Maratha districts, and next the Mahar and Dhed, unclean castes, village servants. Brahmans and Rajputs lead socially. Over 830 castes are recognized, the forty-page index for which, unfortunately, was not bound in the copy of the Digest at hand. Mr. Bourdillon (Bengal) avoids discussion of caste farther than it was necessary for general tabulation of caste enumeration. He quotes the instructions of the census committee of India in this: —

We have no hesitation in saying that there is no part of the work of compilation which presents so many difficulties, involves so much labor, and at the same time is so unsatisfactory when completed, as the working-up of the caste tables."

The committee did not encourage minute research as to caste, and it is only by a sort of cross-examination that we can trace Mr. Bourdillon's views as compared with Mr. Ibbetson's. Under caste, however, he speaks of "the interest of the caste question being much more ethnological than statistical," — the race idea. The Bengal tables deal only with 'Hindu castes;' but Mr. Bourdillon tells us, under 'Religions,' that

The term 'Hindu' now denotes neither a creed nor a race, neither a church nor a people, but is a general expression devoid of precision, and embracing alike the most punctilious disciple of pure Vedantism, the agnostic youth who is the product of western education, and the semi-barbarous hillman who eats without scruple any thing . . . and is as ignorant of the Hindu theology as the stone which he worships in times of danger.

And he quotes approvingly from Mr. Beverley: —

So does the Hindu religion in Bengal assume a Protean form, from the austere rites practised by the shaven pundits of Nuddea to the idol-worship of the semi-barbarous Boona. The Bauris . . . are probably all of aboriginal extraction, but have adopted as their religion a form of Hinduism, and can scarcely be classed as other than Hindus.

In chapter ix., after stating that the Gwalla or the cowherd caste is largest, Brahmin second in numbers, Kaibartha (husbandmen of lower Bengal) third, Mr. Beverley says, "The Koch, who occupy the fourth place, afford a striking example of the way in which Hinduism is replenished," and goes on to explain how a people, once with a language and a religion, as well as a government, of its own, has been absorbed by Islamism and Hinduism, in which latter the converts are, to all intents and purposes, low-caste Hindus. Many names are given that are to be interpreted as occupation or as castes interchangeably, and heredity of caste and of occupation is distinctly named. Under 'Religion' Mr. Beverley gives a general statement of absorption of aboriginal tribes into Hinduism, their ruling classes being absorbed into the warrior caste, while the common people became low-caste Hindus.

The principal point on which there may be a diversity of view as to caste between the census officers is as to its existence among non-Hindu peoples. There is no evidence of antagonism in their general views, and it is not clear that there would not be essential harmony if each wrote fully on the subject.

Other provincial census reports should shortly be received from India, to aid our investigations. Meantime we may recognize some suggestions of caste in the relations of race, occupation, and social position, among western nations. In more than one locality in the United States a lady finds that her cook will not make a bed, the chambermaid will not dress the infant, the nurse will not broil a steak, and, with a houseful of servants, no one will clean the clothes, which are sent to a washerwoman. Actual scavengers have hardly higher social rank in America than in India, where distinction, varying here with daily changes of wealth and of occupation, become moulded into family and religious permanence.

Mr. Ibbetson reminds us that "William Priest, John King, Edward Farmer, and James Smith are but the survivals in England of the four *Varnas* of Menu."

PALMISTRY.

Handbook of modern palmistry. By Prof. V. DE METZ. 2d ed., with 8 illustrations. New York, *Thompson and Moreau, pr.* [1883.] 8+130 p. 16°.

ALTHOUGH written apparently with something curiously like an honest intent, this book is a piece of absurd claptrap, — utterly irrelevant

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e may learn that the palmist art of
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ns. It is perhaps natural that men
to make some interpretations of the
varied lines of the human hand. It
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oks as this mark the remains of the
searching impulse, which, in its first active shape, gave us superstitions, but which, finally united with a critical spirit, gave us true learning. They indicate a stronger survival of the old spirit of superstition than is commonly supposed to continue in educated communities.

Divination has a higher place in the common mind than most well-trained men are disposed to believe: even in our best educated communities, it is still, as of old, a well-paid profession. In the leading paper of Cambridge, Mass., published within a stone's throw of the university, a professed divinator has kept for years a large business-like and soberly worded advertisement of his services. The circulation of this paper is not among the lower classes: on the contrary, its principal *clientèle* is among the more intelligent people. The present writer is informed that a good many speculators base their 'futures' on the predictions they obtain from these wizards. We have managed to varnish our American people with an appearance of modernism; but our school system, with its imperfect scientific training, makes no efficient battle against these pernicious relics of the past. It leaves the child without that sense of natural law which alone can overthrow such superstitions.

We cannot dismiss these indications of a low state of mind with the grin with which one is disposed to treat them. That a considerable part of our people still believe in witchcraft is indeed a serious matter. The machinery of our modern society rests on the theory that men are guided by a common sense of cause and effect. In any serious turn of affairs, when action must rest on the general rationality of the people, those who support these wizards will prove unfit for trust. Our system of education should be shaped to meet this evil. Children should be forced to see that they live under a reign of law: to leave them longer, with nothing to check this strong inherent tendency to base superstition, is to leave rotten timber in the ship of state.

NOTES AND NEWS.

The 'cold-wave flag,' whose use has been inaugurated by the signal-service during the past autumn, is intended to be displayed not only at the regular stations of the signal-service, but also at as many railway-stations and post-offices as possible, in order to spread the widest notice of the coming change of weather. The service cannot at present undertake to provide the flags or to pay for special telegrams to numerous local display-stations; but the cost of the flags (white, six feet square, with a two-foot black square in centre) is moderate, and can easily be borne

by those interested in securing early indications of falling temperature; and in several parts of the country the telegrams are sent to all the stations on certain railroads that co-operate with the signal-service, and thus promptly distribute weather-forecasts to the towns along their routes. It is probable that the coming year will see a considerable extension of this kind of weather-service.

—The report on the terminal moraine in Pennsylvania, by Prof. H. Carvill Lewis, published by the geological survey of that state, gives the detailed observations on which was based the *résumé* that has already appeared in *Science* (ii. 163). The volume opens with a characteristic preface by Professor Lesley; and the description of the moraine along its irregular course follows in nearly three hundred pages, with numerous sketch maps and artotypes. The latter illustrate types of landscape having a strikingly glacial form, especially well shown in the morainic deposits of Cherry valley, Monroe county (pl. x., xi.); and include a remarkably fine view of a scratched bowlder (pl. v.). Students of glaciology are already familiar with observations showing the small regard paid by the ice-sheet to hills and ridges in its path. The effects of a similar indifference to local topography are seen in the direct course of the moraine across valleys; for the opinion that separate glaciers ran down each river-valley like a series of tongues projecting beyond the margin of the united glacial sheet is not sustained by Professor Lewis's investigations. The same report contains a note by Professor Lesley describing a remarkable monument—if a hole can be so called—of glacial action. This is a pot-hole found last winter by the men at work in the Ridge (coal) mines of Messrs. Jones, Simpson, & Co., Archibald, Luzerne county, Penn. It is twenty feet in diameter and forty feet deep, and when found was full of round stones, gravel, and fine sand; on removing this, the walls of the natural air-shaft were disclosed, showing the sandstone cut through clean and smooth, down and into the underlying coal-bed. The adjoining coal was found in perfect condition. Flanges of rock rise spirally from the lower part of the cavity toward the surface. The cut here given is taken from a photograph by Mr. Henry Frey of Scranton, Penn., who has also published larger views, looking out of as well as into the hole. A second pot-hole is also reported, two miles from the above locality, near Messrs. Winton & Dolph's mines.

POT-HOLE FOUND IN A PENNSYLVANIA COAL-MINE.

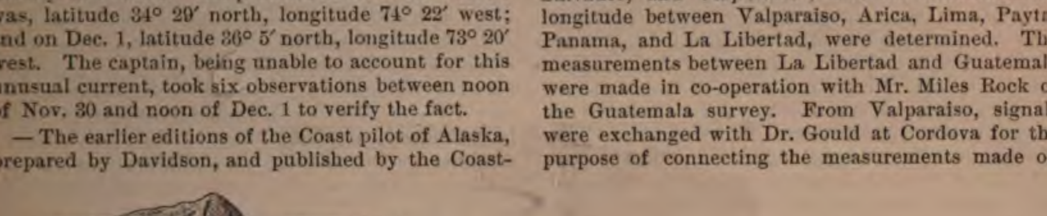
In the October number of the *American journal of science*, Mr. Lewis discusses the validity of observations on supposed glacial action at eleven points in Pennsylvania south of the terminal moraine, all of which he has visited. He concludes that they are all non-glacial, some being simple water-worn gravels, others being ice-rafted bowlders, while the scratches reported in two localities are pronounced slickensides and plant-fossils. The glacial action reported in Virginia needs similar re-examination.

—Capt. H. W. Chetwynd, R.N., chief inspector of lifeboats in Great Britain, having been directed to test the use of oil in calming troubled waters, reports that his experiments show that there is little difference in the effect produced by the various oils of every-day use; very small quantities of either colza, linseed, fish, seal, or paraffine oil being found sufficient to cover a considerable space with the smooth glassy surface characteristic of oil on water. The effect of this oily film was most marked on moderate breakers, as it entirely stopped their breaking, and left only a gentle swell; but, on surf such as might endanger the safety of a lifeboat, the oil had but little and often no calming effect. On several occasions, when a larger breaker than usual rose in a moderate surf which the oil had 'killed,' the oil was powerless to check it; and the sea broke through it, covering the boat, gear, etc., with oil. It failed, also, to have an effect on breakers caused by a heavy ground-swell. To be any protection, oil must be applied to the sea from the boat or vessel in the direct line from which the seas are advancing, and at a sufficient distance to give it time to spread and act upon the waves before they reach the vessel. This could be done in a lifeboat only in two positions: 1. When anchored, and lying head to sea and tide; 2. When running dead before the sea for the shore. In any other position, even supposing the oil to be calming the water, it would probably be impossible to keep the boat within its influence, and proceed towards a wreck or other desired point, at the same time. Under these circumstances, Capt. Chetwynd is of the opinion that no practical advantages can arise from the use of oil by the lifeboats of his institution, and he cannot recommend its being issued to them. He states,

however, that these experiments clearly demonstrate that in many cases it would prove a material protection to ordinary open boats in a dangerous surf, and he strongly urges its adoption for use in such cases.

— Capt. Klein of the German bark Kron Prinz von Preussen, making passage from Rio de Janeiro to Baltimore, reports encountering on Nov. 30 and Dec. 1 a very strong current from south-east one-eighth south, which he estimated at 3.2 knots per hour. The wind was blowing a whole gale from the north-east and north, and his vessel was hove to for twenty-four hours. His position at noon on Nov. 30 was, latitude 34° 29′ north, longitude 74° 22′ west; and on Dec. 1, latitude 36° 5′ north, longitude 73° 20′ west. The captain, being unable to account for this unusual current, took six observations between noon of Nov. 30 and noon of Dec. 1 to verify the fact.

— The earlier editions of the Coast pilot of Alaska, prepared by Davidson, and published by the Coast-survey in 1867 and 1869, are now succeeded by a new work, exhaustive of all known sources of information, compiled by Mr. W. H. Dall, assisted by Mr. Marcus Baker. This is entitled 'Pacific coast pilot, Alaska, part i.,' and gives sailing-directions, with charts and views, for the inland passage from the north end of Vancouver's Island to Dixon's entrance, and thence along the coast of our distant possessions to Yakutat Bay, where the shore-line turns westward. Much additional surveying is needed to attain final accuracy, as the coast is fringed with many islands, and is greatly broken by long, irregular fiords. In the northern part especially, it is bold and mountainous, and numerous glaciers descend close to water-level. The accompanying figure gives a view of Kasa-an Bay, and recalls the abruptness of the Norwegian coast.



KASA-AN BAY, CAPE GRINDALL, E. ¾ N. 12 MILES. (*From U.S. Hydr. Office, Chart No. 225.*)

— *Nature* states that Prof. G. H. Darwin of Cambridge, and Professor Daniel Oliver of the Royal gardens, Kew, have been nominated by the council of the Royal society for the award of the two royal medals conferred by the crown. The Copley medal is to be given to Professor Carl Ludwig of Leipzig, in recognition of the great services which he has rendered to physiological science; Professor Tobias Robertus Thalén of Upsala is to have the Rumford medal for his spectroscopic researches; and the Davy medal is awarded to Prof. A. W. H. Kolbe, also of Leipzig, for his researches in the isomerism of alcohols. The two Leipzig professors are foreign members of the society. Professor Darwin and Professor Oliver are fellows, — the former well known for his mathematical investigations on the rigidity of the earth and on tides; the latter, for his investigation of the classification of plants, and for the important services which he has rendered to taxonomic botany.

— The work of establishing secondary meridians of longitude on the west coast of Central and South America by means of the submarine cable, which was undertaken by Lieut.-Commander C. H. Davis, U.S.N., has been completed. Stations were established at various points between La Libertad, San Salvador, and Valparaiso; and the differences of longitude between Valparaiso, Arica, Lima, Payta, Panama, and La Libertad, were determined. The measurements between La Libertad and Guatemala were made in co-operation with Mr. Miles Rock of the Guatemala survey. From Valparaiso, signals were exchanged with Dr. Gould at Cordova for the purpose of connecting the measurements made on the west coast with those made on the east coast of South America in 1878 and 1879. The observations are now being reduced, and prepared for publication.

— The bureau of navigation of the Navy department announces that the computations and discussions of the observations and experiments for determining the velocity of light have been completed, and are being prepared for publication.

— The Navy department reports that the 'electric plant' for incandescent lighting, which was supplied to the U. S. S. Trenton, has given great satisfaction, notwithstanding some defects in the insulation of the wires, and has added materially to the comfort and health of the officers and crew, and therefore the Atlanta, Boston, and Omaha are to be lighted by electricity. The plant for the Atlanta will be supplied by the U. S. electric-lighting company of New York; that for the Boston, by the Brush electric company of Cleveland; and that for the Omaha, by the Consolidated electric-light company of New York. The merits of the various systems may thus be determined.

— A group of beetles known as the Stenini has received attention at the hands of Lieut. Casey in a brochure of more than two hundred pages. It brings us another step toward the aggregation of the material for a more or less complete monograph of our Staphylinidae. The work has been carefully and conscientiously done from the author's stand-point, and but little adverse criticism can be made except in the

following particulars: there is an evident tendency to divide species upon small details of sculpture, fortunately checked, as the author admits, where the specimens are numerous; but the summary admits eighty-eight species in a hundred and seventy-two, founded on only one and two specimens, — an unparalleled percentage in any monographic work on Staphylinidae ever published. The descriptions are unnecessarily verbose and tiresome, and could have been abbreviated by half with advantage to both author and reader. The division of Stenus, in which the author believes himself to have taken the initiative, is unnecessary and untenable. The genus Areus of Casey has already been separated by Motschulsky (*Bull. Mosc.*, 1860, i. 556) under the name Hemistenus, but has found no followers.

— The American brigantine Senoruta was in latitude 35° 50′ north, longitude 74° 12′ west, at meridian, Nov. 16, and experienced the severe storm of that date. About two P.M., when it was blowing very hard from the north-east, five whirlwinds were seen to the southward and eastward. They were black columns of water about four hundred feet in diameter, and their tops seemed to reach the clouds. They moved with great velocity at right angles to the wind, and, after passing the vessel, disappeared to the northward and westward. Four went ahead of the vessel, and one astern, within a half-mile. The whirlwinds were moving at the rate of twenty-five or thirty miles an hour. The appearance of waterspouts in the midst of a gale, and moving at right angles to the wind, is quite unusual.

— The molluscan fauna of the Silurian period in Götland is illustrated in a fine quarto, with numerous plates by Prof. G. Lindström of Stockholm, published by the Swedish academy. It comprises the gastropods and pteropods, and is, perhaps, the first paper which treats at all fully of the Silurian members of these groups, and contains much of interest, both new and old. A Silurian genus of Chitons (Chelodes), a remarkable Patellid (Tryblidium), and a very large number of forms allied to the recent Pleurotomariae, are fully described. The presence of Subulites, and other siphonostomatous gastropods in Silurian times, is demonstrated, and some extremely singular new genera made known. The text is in English, and the whole work extremely creditable to its learned author, and useful to the paleontologist.

— An additional discovery by Dr. Lindström, in the same rocks, is worthy of special notice. In beds which are said to be the equivalent of our Niagara group, he has discovered a remarkably well-preserved scorpion, of which a photograph is before us. That it was air-breathing, though found in a purely marine deposit (into which it was probably washed), is proved by the fact that one of the stigmata is plainly visible. Dr. Thorell, one of the foremost students of Arachnida in the world, and Dr. Lindström, are preparing a paper upon it, and have given it the name of Palaeophoneus nuncius. No scorpions, nor indeed any Arachnida, have before been found fossil in beds lower than the carboniferous deposits, in which some twenty-five species have been found in this country and Europe; yet this Silurian example is more perfect than any specimen of a fossil scorpion from any formation. It presents some marked peculiarities, but it seems to be unquestionably a scorpion.

— In his 'Contributions to the tertiary geology and paleontology of the United States,' Prof. A. Heilprin has collected a series of six papers, mostly from the publications of the Philadelphia academy of sciences. Mr. Heilprin does not recognize the existence of any pliocene strata in the eastern and southern portions of the United States. A map which is added embraces only the tertiaries of the Atlantic and Gulf coast regions, and the lower Mississippi valley. This is the first time that a succinct statement of the tertiary geology of the eastern United States has been attempted; and Professor Heilprin has produced a work which will be valuable to those who may undertake the exhaustive study of the eastern tertiaries, which they so much need.

— In a paper read before the Linnean society of New South Wales, Oct. 29 last, Dr. Lendenfeld contests the views of the French physiologists, that the position and movements of the wings of insects are merely the results of the mechanical influence of the resisting air, and gives instances where muscular contraction had been clearly proved.

— The committee on organization of the Ninth international medical congress, to be held in the United States in 1887, met in Washington, D.C., on Nov. 29, 1884, for the determination of the general plan of the congress, the election of officers of the committee who will be nominated to fill the same offices in the congress, and the consideration of questions of finance. The officers elected are as follows: president, Dr. Austin Flint, sen., of New York; vice-presidents, Dr. Alfred Stillé of Philadelphia, Dr. Henry I. Bowditch of Boston, Dr. R. P. Howard of Montreal, Canada; secretary-general, Dr. J. S. Billings, U. S. army; treasurer, Dr. J. M. Browne, U. S. navy; members of the executive committee (in addition to the president, secretary-general, and treasurer), Dr. I. Minis Hays of Philadelphia, Dr. A. Jacobi of New York, Dr. Christopher Johnston of Baltimore, Dr. S. C. Busey of Washington. The executive committee will proceed at once to complete the work of organization.

— The next meeting of the Society of naturalists of the eastern United States will be held at Washington, D.C., on Monday and Tuesday, Dec. 29 and 30, 1884. By the courtesy of the Smithsonian institution, the society will have the use of the lecture-room of the institution for its meetings. The first session will be on Monday the 29th, at ten A.M. promptly. It is expected to have a discussion on the teaching of natural history in colleges.

— The San Diego society of natural history has received an addition to its herbarium of seven hundred species of southern and lower Californian plants. This series of plants will be known as the Orcutt herbarium.

SCIENCE.

DECEMBER 26, 1884.

TMAS GREETING.

an infant, having scarcely at-
two years, *Science* does not
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all times been worshipped by
it has been reduced to nothing
of fire rolling on through space,
fixed by Sir Isaac Newton, his
many of them abandoned him.
: souls it occurred that their old
: fail them so utterly; and they
ow his influence on the growth
e of stocks, and the pointing of
this there is more in the open-
y would also call attention to
has in bringing out the flowers,
s, and the insects that the birds
1 to feed. We had not meant to
shippers such vantage-ground;
n the pages, we find something
about the variations of tempera-
points in the United States, and
y lines the points at which the
emperature for the year is the
ena which depend on the sun, — and certain advice to farmers which would be of little avail if the sun should fail to perform its part. Whether earthquakes can be made to depend on the sun, we dare not say; but there are those who would not deny him even that power.

But at last we find some small evidence of a revolt against the tyranny of the sun. For years people would rise as the sun rose, they aimed to eat their dinners as the sun crossed the meridian, and they donned their nightcaps as the sun went down. A few wise men have long pointed out that the sun had by no means the regular habit he had the credit for; that often good people had eaten their pudding, and got well into their broth, before the sun had crossed the noon-mark. This is all changed. Man now gets up by a railway-whistle, eats his dinner by a railway-whistle, and counts his sleepless hours at night by railway-whistles. That it may be clear just how these whistles blow, we give a map showing the limits of railway-time. So the sun at last has lost a part of his former pre-eminence, and yielded it to the railway-king.

The natural instinct with each of us is to live within himself; he is quite startled when, at times, he notes that he is only one among a large community; and, as we view with indifference the toils of some distant Tasmanian, so does the Tasmanian live in utter ignorance of our toils. The maps of the stars we give are from some point in the solar system. We look at the stars as pretty, bright objects in a frosty sky. Suppose the maps made from the point of view of a dweller in the planetary system about σ Draconis: would our sun be given?

The innovations which science has brought to pass have startled a few; to allay which fear, *Science*, casting about in search of an anchor still left to which a well-regulated life may be moored, has hit upon the almanac, and therefore gives up the closing pages to such data of sun and moon risings and settings, of high tides and low tides, of planets good and planets bad, as may enable all its readers to know at least when it is day, and when night.

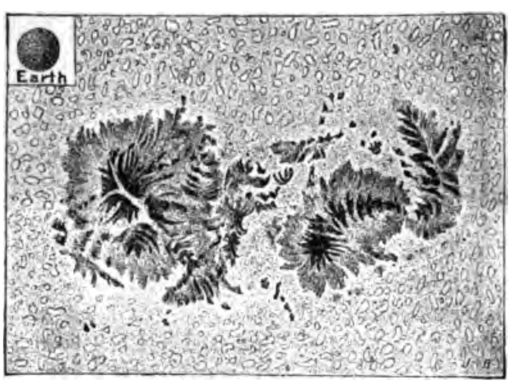
SUN-SPOTS AND THE EARTH.

"If dusky spots are varied on his brow,
And, streaked with red, a troubled color show;—
That sullen mixture shall at once declare
Winds, rain, and storms, and elemental war."
DRYDEN.

ONE of the most interesting questions of modern astronomy is whether sun-spots produce any effect upon terrestrial affairs, and, if so, of what nature is their influence, and how extensive?

It is an important question too; for, if they really do exert any thing like a commanding authority, then our knowledge of the laws that regulate their extent and frequency will give us a power of prediction, in respect to coming seasons, of the greatest value in all agricultural and commercial operations.

It was ascertained long ago (first by our own Henry), that as a sun-spot is darker, so also it is



SUN-SPOT AS SEEN JUNE 30, 1883

cooler, than the bright surface of the sun. According to the observations of Professor Langley, the black nucleus or *umbra* of a spot emits only about fifty-four per cent as much heat as an equal area of the normal surface; and the *penumbra*, the shaded fringe around the nucleus, about eighty per cent. If, then, any considerable portion of the solar surface were ever covered by the spots, we should reasonably expect a notable falling-off in the sun's light and heat, and an unmistakable effect upon climates and the weather.

It has been found, however, that, even in the most extreme cases yet observed, the portion of the sun's surface actually occupied by the spots is relatively very small, seldom amounting to a five-hundredth of the whole, and then only for a few days at a time. The direct temperature effect of sun-spots is therefore still more minute, never reaching a thousandth of the sun's whole heat.

But while their direct effect is thus insensible, it does not seem impossible, nor even improbable, that the spots might be indicative of an abnormal condition of things upon the sun's surface, such as would seriously affect the earth's revenue of heat. We might suppose, for instance, that they are symptoms of a general chilling of the solar surface, or, on the other hand, that they are caused by some ebullition from beneath the surface, which would, on the whole, raise the temperature instead of lowering it, and so compensate, or even overbalance, the effect of their darkness.

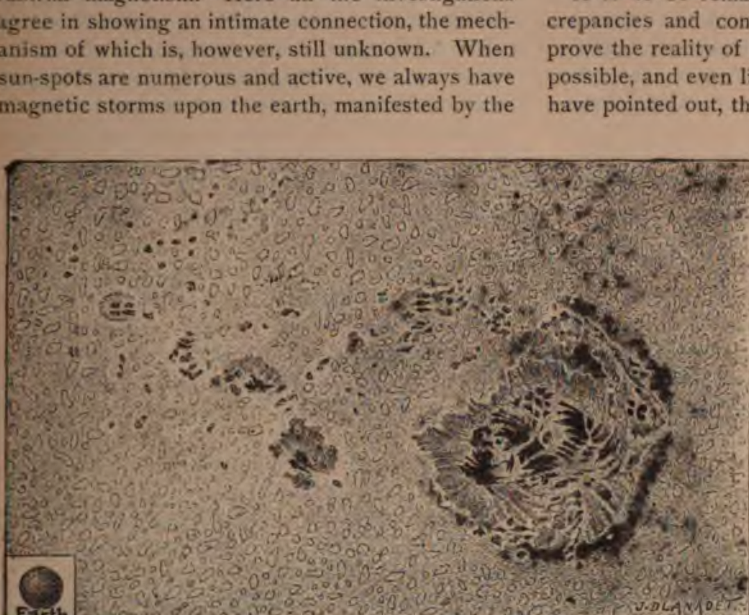
In regard to this, it is now only possible to say that the change, if any, is too slight to be detected by our present means of observation. It is earnestly to be hoped, that before long some apparatus and method of observation may be devised delicate enough to deal with the problem; but at present they do not exist, and no one knows with certainty whether the sun's radiation is increased or diminished when sun-spots are most prevalent.

A priori, then, we have no reason for expecting any perceptible effect of sun-spots upon the earth's conditions. But, on the other hand, it would not do to assume that they have none; that a variation in the sun's heat, even too small to be directly measurable, may not *indirectly* produce very important consequences by disturbing some nicely adjusted equilibrium. The gentlest touch of a child's finger may depress a key, and fire a mine. It is easy to imagine many ways in which an extremely slight change in the temperature might occasion, if it did not strictly cause, such alterations in the cloudiness, or in the direction and velocity of winds, as would seriously modify the climates and the fertility of large regions of the earth. The question is simply one of fact.

Since, however, it has been discovered that there is a somewhat regular, though unexplained, increase and decrease in the number and extent of the sun-spots (with a period of about eleven years), we are in a position to investigate the subject statistically. It is only necessary to compare the tabulated data relating to the spots with those relating to temperature, barometric pressure, magnetic disturbance, rainfall, height of water in rivers,—every thing, in fact, that fluctuates in our terrestrial affairs: we may even justifiably and properly include in our inquiries such matters as the price of grain and stocks, financial crises, and epidemic diseases. If in any case we find that in a sufficiently long run

the variations in the sun-spot data correspond exactly to those relating to the element under examination, we shall be compelled to admit some sort of a causal connection; and that, even if the nature of the connection is inscrutable.

Numerous such comparisons have been made during the past twenty-five years. So far the results must be pronounced indecisive, except as regards the effects of solar disturbances upon terrestrial magnetism. Here all the investigations agree in showing an intimate connection, the mechanism of which is, however, still unknown. When sun-spots are numerous and active, we always have magnetic storms upon the earth, manifested by the aurora-borealis and by strong disturbance of our compass-needles.



SUN-SPOT AS SEEN JULY 25, 1883.

The investigations in regard to other elements have, as Professor Langley says, "nearly every one brought out some result which might be plausible if it stood alone, but which is apt to be contradicted by the others." For instance: Dr. Gould in South America, and Mr. Stone at the Cape of Good Hope, think they have detected a slight lowering of temperature, amounting to one or two degrees, at the time of sun-spot maximum; while at Edinburgh, Smyth reaches a similar conclusion, except that the minimum temperature follows the sun-spot maximum at an interval of about two years. On the other hand, Chambers, from twenty-eight years' observations in India, finds a *rise of temperature* coinciding with the sun-spot maximum; and, in opposition to all the others, Jelinek of Prague, from all the observations he could collect in Germany up to 1870, obtained a purely negative result. Discrepancies of the same sort appear in the results of other investigators, with reference to the rainfall and the height of rivers in different parts of the earth; though, on the whole, they seem to show a slight increase in the rainfall (one or two per cent) at or near the time of spot-maximum.

It is to be remarked, however, that these discrepancies and contradictions by no means disprove the reality of sun-spot influence. It is quite possible, and even likely, as Dr. Gould and others have pointed out, that slight changes in the sun's radiation might be felt mainly by their effect in disturbing atmospheric currents, and so altering the distribution of heat and moisture, rather than by any general effect. In this case, the effects in neighboring regions would evidently be exactly opposite in character.

As matters stand, it is clear, in the first place, that a much longer period of observations will be needed to settle the question decisively as to the reality of sun-spot influence; and, in the next place, that, if the influence is real, it is only slight, and so masked by other effects as to be difficult of detection. There can be no reasonable expectation that the ordinary variations in the state of the solar surface will prove to be dominant, or even very important, in terrestrial meteorology, or in human conditions that depend upon climate and the weather.

THE INSECTS OF THE YEAR.

"Fairy bands
Sailing, 'mid the golden air,
In skiffs of yielding gossamer."
HOGG.

THE seasonal appearance of insects varies. Some species are found during several months, others at all times of the year; some vary in date of appearance with the earliness or lateness of the

season, while others appear quite punctually, regardless of the season. In the same locality the peach will blossom one year in February, another not till May; and there is similar variation in the first appearance of spring insects. The irregularity lessens, however, as the growing season advances. July is more uniform than April. From Boston to Enterprise, Fla., one may travel in a couple of days in January from ice-bound midwinter to summer temperature, and, with the progress southward, activity in both plant and insect life increases. In a country so vast that it represents sub-boreal and sub-tropical temperatures at one and the same time, it were eminently improper to speak of the appearance of an insect without specifying the latitude. The midwinter difference between Maine and Florida, however, is not the difference between dead of winter, and height of summer; because there is, even in the subtropical sections, a winter or hibernating period when insect-life is comparatively at a stand-still, or dormant.

For calendar purposes the country may be divided into northern, middle, and southern; and, where not otherwise stated, the following index to the first appearance of some of our more conspicuous insects will have reference to some middle latitude. St. Louis is a very good point, being central between the Atlantic and the Rocky Mountains, our northern boundary and the Gulf; while Washington is another, lying well between our northernmost and southernmost borders. Between the Gulf and Lake Superior there is a difference in earliness of spring forms of nearly two months, or of four to five days with each degree of latitude, as the history of the Rocky-Mountain locust (Caloptenus spretus) and of the army-worm (Leucania unipuncta) shows. This difference, as already indicated, diminishes for summer forms. Development quickens in adaptation to the shorter northern season: and a widely distributed species, that does not mature till August in Missouri, or even Texas, may appear but a few days later in Minnesota.

January. — Hushed in a frosty cradle, as most lower life is at this season, the snow-fleas (genus Podura) — little, black, springing creatures not more than one-twentieth of an inch in length — may nevertheless be seen during a mild spell, abounding on the snow, even in the more northern states. To the southward, whenever the temperature is above freezing-point, the farmer will start from his corn-shocks various hibernating bugs, as the chinch-bug (Blissus leucopterus) and the tarnished plant-bug (Lygus lineolaris); while the housekeeper may be alarmed by the buzzing of the paper-wasps (genus Polistes), and particularly Polistes metricus and P. annularis. Still farther south many butterflies, especially the yellows (genus Colias) and the whites (genus Pieris), so common everywhere later in the season, may be observed.

February. — In average or normal years the insect-life of this month resembles that of the preceding. On mild days swarms of small gnats (Chironomidae) dance in the air near still waters, while near larger streams small sombre-colored Neuroptera (Perlidae) will often fly. The wingless female of the spring canker-worm moth (Paleacrita vernata) ascends the trunks of apple and elm trees, while the male, with ample wings, flits about her. In the extreme north the remarkable wingless and spider-like dipteron (Chionea valga) and the equally remarkable neuropteron (Boreus nivoriundus), also wingless in the female sex, may be seen upon the snow; while in the south our heaviest-bodied butterfly (Megathymus yuccae) and our most graceful species (Heliconia charitonia) are conspicuous, — the one darting swiftly among the yuccas, the other slowly sailing through the dense underbrush of the shady hammocks.

March. — Insect activity now rapidly increases. With the thawing of the ice in ponds and ditches, the water-beetles (Dytiscidae) appear, while in the woods many species of ants (Formica) make their way from their subterranean abodes. Many pine-boring beetles (Buprestidae and Scolytidae) are seen, and a small dung-beetle (Aphodius inquinatus) flies in countless numbers. The velvety brown larva of Telephorus will follow the melting snow, the brown and black hedge-hog caterpillar (Arctia isabella) will scamper across a sun-warmed path, and the dipterous Bibio larvae will be found in masses under decaying leaves in the garden. Of butterflies, the mourning-cloak (Vanessa antiopa), with its beautiful purple-brown and cream-margined wings, somewhat the worse for wear, is conspicuous; and, of moths, the cotton-worm moth (Aletia xylina), the army-worm moth (Leucania unipuncta), and Platyhypena scabra, are noteworthy in the south.

April. — The first flowers of spring, and especially the catkins of willows and poplars, teem with insects of many orders, but especially the Hymenoptera of the genera Andrena, Halictus, Melissodes, and Nomada, which have issued from their underground nests. The honey-bee (Apis mellifica), the carpenter-bee (Xylocopa virginica), and the bumble-

bee (Bombus) are conspicuous. Among Coleoptera, the blister-beetles (Meloidae) and the tiger-beetles (Cicindelidae) are noticeable; and the painted clytus (Cyllene pictus), with its black-and-yellow banded coat, will be common in houses where hickory-wood is used in the fires. Among Lepidoptera, the blues (Lycaenidae), the monarch or milk-weed butterfly (Danais archippus), the Graptas, and Eudamus bathyllus will be seen. Among Orthoptera, the Acridium americanum and Oedipoda phoenicoptera will be noticeable among wintering forms on account of their large size.

May. — In this month the hibernated legion is warmed to new life, and the number of species occurring is too great to warrant special indication. The large tiger swallow-tail (Papilio turnus) darts swiftly about, while a lot of humbler butterflies are seen. Those gigantic beauties of the night, the Cecropia moth (Platysamia cecropia) and the Polyphemus moth (Telea polyphemus), are seen hanging listless as they just issue from their cocoons, or pass bat-like at dusk overhead. Some of the hawk-moths (Sphingidae) already begin to hover at twilight, humming-bird fashion, over honeysuckle and other honey-yielding flowers. The carpenter moth (Xyleutes robiniae) will be found early in the morning, resting on the trunk of the black locust, from which the empty pupal exuvium sticks out as an index. A host of Hymenoptera make their advent; and noticeably the gigantic saw-fly (Cimbex americana) will be found ovipositing in willow leaves, and the pigeon Tremex (Tremex columba) in old maple trunks. The buffalo-gnat (Simulium) swarms in the lower Mississippi country to the injury of all kinds of stock. The fruit-grower finds the plum curculio (Conotrachelus nenuphar) making its dreaded crescent-mark on his fruit, and the canker-worms blighting his apple-trees. The house-keeper observes with dread the various clothes-moths (Tinea) and the carpet-beetle (Anthrenus scrophulariae). But the latter part of the month is chiefly characterized, first, by the hosts of delicate May-flies (Ephemeridae) which issue from our rivers in the sub-imago state, and, attracted to the light, crowd on windows and around lamps; second, by the swarms of more robust May-beetles (Lachnosterna fusca), which begin to defoliate oak-groves and poplar-trees.

June. — During this leafy month, when nature's pulses beat most strongly, insect-life is at its acme. The army-worm marches through meadow and grain-field, and a host of destructive species gather force and spread dismay. The woods and meadows abound in gaudy butterflies, and multiform caterpillars feed voraciously. The commoner firefly (Photinus pyralis) rises slowly from the moist ground at eve, and intermits its soft, glowing light. But the month is chiefly characterized by the appearance of that singular periodical, or seventeen-year Cicada (Cicada septendecim), with its *tredecim*, or thirteen-year race. The woods rattle with its hoarse beat about the first of the month, and broods appear in some locality or other nearly every year. The present year (1885) is a memorable one; for a very extensive seventeen-year brood, which appeared last in 1868, and has been fully recorded every seventeen years since 1715, may be looked for on Long Island and in Monroe county, N.Y., in south-eastern Massachusetts, in parts of Vermont, Pennsylvania, Delaware, Maryland, Virginia, District of Columbia, in north-western Ohio, in south-eastern Michigan, in Indiana, and in Kentucky.

July. — With the great heat of July there is less variety of insect-life than in June, and the month is chiefly notable for the tormentors. Horse-flies (Tabanidae) interfere with the ploughman's work, mosquitoes swarm to such an extent in the north-west as to render travel for both man and beast positively dangerous, while the bot-flies (Oestridae) attack horses, cattle, and sheep. The nests of the tent-caterpillar (Clisiocampa americana) and of the fall web-worm (Hyphantria textor) disfigure orchard and forest, and the tumble-dungs (Canthon) assiduously roll their balls of dung. The harsh rattle of the dog-day harvest-fly (Cicada canicularis) is also first heard.

August. — In this month the fossorial Hymenoptera most abound, and the numerous locusts (Acrididae) begin to get their wings, and reach their greatest destructiveness. The katydids and the tree-crickets also become full-fledged, and join the other insect stridulators which fill the late summer and autumn nights with sound. The cotton-worm does its greatest mischief in the south, and the chinch-bug leaves the wheat-fields for the maize. Many true bugs (Hemiptera) get their wings, among which the wheel-bug (Reduvius novenarius) is conspicuous. The dragon-flies (Libellulidae) are more numerous, and the mantis (Mantis carolina) and the walking-stick (Diapheromera femorata) acquire full growth, and are more noticeable than formerly.

September. — Many of the insects of the preceding month are still more noticeable in this, while few new ones appear. The blister-beetles and a vast number of smaller Hymenoptera abound on the flowers of the golden-rod; and most species are

busy providing for their issue, or preparing for winter quarters.

October. — This is the month when spiders of all kinds are most noticeable, their gossamer threads glistening high up in the air, or their webs disfiguring shrubs and buildings. Immigrant plant-lice come on the wing to store away the winter egg on congenial trees; and the other insects most noticeable are those which hibernate, and are getting ready to do so. The buck moth (Hemileuca maia) flies quietly, with its delicate crape-like wings, among the dropping leaves of the forest, and is the species most peculiar to the month.

November. — In this month most insects are hushed in death or torpor; but the fall canker-worm moths will rise from the ground after a severe frost, and many hibernating Hymenoptera and Coleoptera will take an airing when the weather is mild. The cluster-fly (Pollenia rudis) holds out against the cold much longer than the house-fly, which it so much resembles.

December. — Nothing peculiar marks this month; but most of the species mentioned for both November and January may be seen in December, when the temperature and circumstances favor.

WEATHER FORECASTS.

"*Another storm brewing; I hear it Sing i' the wind.*"

SHAKSPEARE.

THE methods by which weather forecasts are made are based almost wholly upon facts of observation rather than upon established deductions of science. This is unavoidable, because atmospheric movements are very complicated, and because the science of meteorology is not yet sufficiently advanced to satisfactorily explain them in the detail necessary for successful forecasting.

The leading fact upon which predictions depend is that atmospheric conditions advance in a direction generally easterly. The motion may vary in velocity, but in direction is usually between north-east and south-east, rarely towards any other point of the compass. During this advance, changes in condition may occur; and it is necessary to foresee the character of these changes, as well as the direction and rate of motion. The indications of the barometer are the chief aid in understanding the weather conditions themselves, and the changes which may be expected. At any given moment there exist, in the territory occupied by the United States, differences in the atmospheric pressure which may amount to two inches in the height of the barometer. Usually there are one or more areas of pressure above the average, and one or more below the average, the pressures at intermediate points lying between the highest and lowest values. Each of these areas of high and of low pressure is accompanied by its peculiar conditions, and is moving towards the Atlantic coast with varying velocity. Thus the low area, if its centre is more than two or three tenths of an inch below the average pressure, is accompanied by clouds, and rain or snow, and forms a storm. The area of high pressure is usually attended by clear skies; and the radiation of solar heat to the earth during the day, or from the earth at night, is unchecked by clouds: consequently in summer, when the days are long, the temperatures which accompany an area of high pressure are above the average; while in winter, when the nights are long, low temperatures are found with high pressures. Many similar facts have been learned from the study of meteorological observations, upon which dependence is placed in weather-predicting.

Under the auspices of the U.S. signal-service, observations are made three times each day at a hundred and twenty-nine stations suitably located. Each of these observations is made at the same moment (seven A.M., three P.M., and eleven P.M., Washington time), and includes determinations of the atmospheric pressure, the temperature and humidity of the air, the direction and velocity of the wind, the kinds and motion of clouds, and other meteorological data. The results are at once telegraphed to the central office, and maps formed which show graphically the conditions at the moment of observation, and the changes which have occurred in the past few hours. From these maps a detailed prediction is made for the twenty-four hours following, based upon the conditions which exist at the time, the changes which have occurred, and the changes which, former experience shows, usually follow similar conditions.

The weather prediction thus assumes that coming changes will agree with the changes noted in former times under like circumstances. This is true on the average; but, whenever exceptions occur, the prediction fails. Increased skill in predicting depends upon increased skill in anticipating these exceptional cases. At the present time the government predictions are verified in eight cases out of ten. Reliable forecasts cannot be made for a period longer than twenty-four hours,

though it is hoped that an increase in the time may be successfully made at some future day. There is needed a better understanding of the laws which underlie atmospheric changes, so that empirical generalizations may give way to scientific deductions.

EARTHQUAKES IN THE UNITED STATES AND CANADA.

*"Some say, the earth
Was feverous, and did shake."*
SHAKSPEARE.

THE part of the earth's surface occupied by the United States is not generally regarded as much affected by earthquakes. As compared with some other localities, this is true; yet records show that moderate earthquakes are not so infrequent here as is usually supposed.

In the twelve years from 1872 to 1883 inclusive, three hundred and sixty-four earthquakes have been recorded as occurring in Canada and the United States, not including Alaska. Their geographical distribution may be expressed in this way. Suppose the country divided into three districts, — one extending from the Pacific Ocean eastward, to include Idaho, Utah, and Arizona, which may be called the Pacific slope; the second extending from Montana, Wyoming, Colorado, and New Mexico eastward, to include Ohio, Kentucky, Tennessee, and Alabama, which may be called the Mississippi valley; and the third, or Atlantic slope, extending eastward again to the Atlantic Ocean, and including the Appalachian region from the St. Lawrence to Florida and Georgia. Then the distribution of these three hundred and sixty-four earthquakes has been

Pacific slope	151
Mississippi valley	66
Atlantic slope	147
	364

These numbers indicate that about once in twelve days an earthquake occurs *somewhere* in the United States or Canada, and about once a month one occurs somewhere on the Atlantic slope.

It is quite likely, also, that for every earthquake which is of sufficient intensity to get itself noted in the midst of our busy American life, several lighter tremors may have occurred, which, although not violent enough to attract the attention of any one, would yet have left their record on a properly constructed seismoscope.

So, if any of our readers feel disposed to set up a seismoscope, they need not be deterred by the paucity of shocks in our country. A seismoscope anywhere along our eastern seaboard, or, still better, on the western coast, might fairly be expected to record ten or a dozen shocks in the course of the year, and might detect a much larger number. Such observations would be of high scientific value.

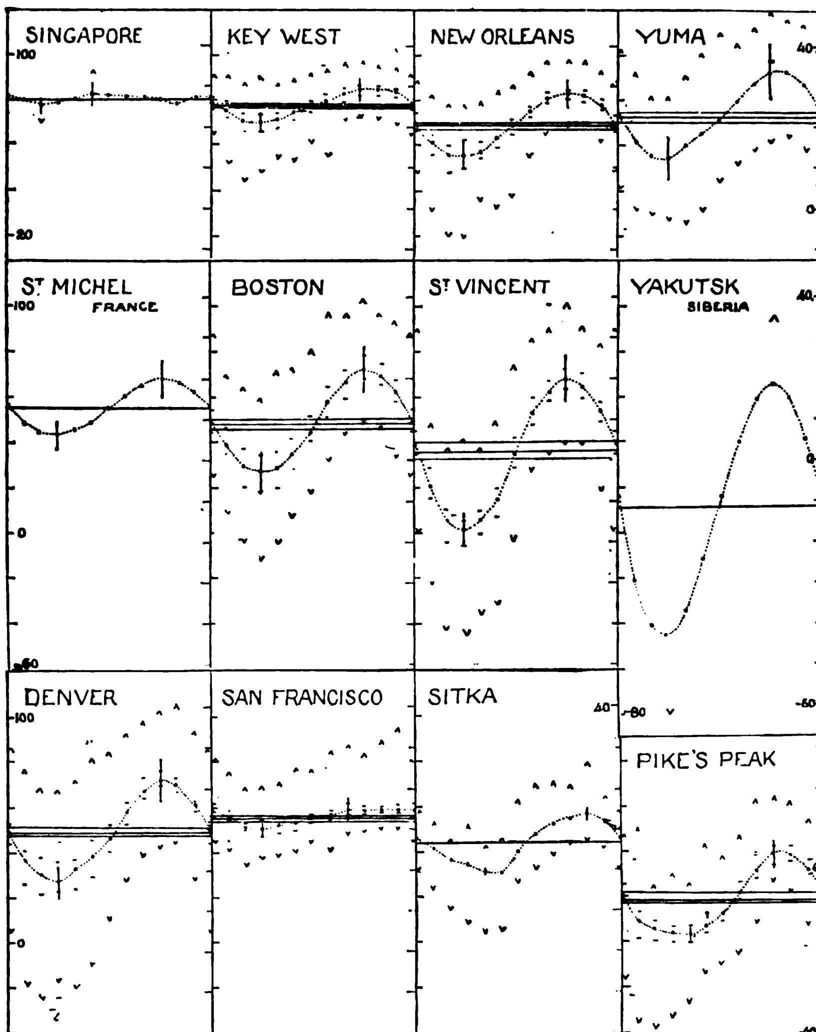
TEMPERATURE AND ITS CHANGES IN THE UNITED STATES.

*"For hot, cold, moist, and dry, four champions fierce
Strive here for mastery."*
MILTON.

IN the United States the changes of temperature with the seasons are of several types. These are illustrated in the accompanying diagrams, constructed chiefly from our signal-service reports; the thermometric scale being indicated by marks for every twenty degrees Fahrenheit on the left, and for every ten degrees Centigrade on the right, of each local division. The middle horizontal line shows the measure of that arithmetical abstraction commonly known as the mean annual temperature; and the adjoining lines above and below indicate how much variation there may be in the means of different years. In this respect, St. Vincent, Minn., has a much more irregular climate than Key West. The dots connected by a fine, dotted, curved line, represent the mean monthly temperature, beginning with October on the left side, descending to the January minimum, crossing the mean annual line about April, on the way to the July maximum, and descending again to October on the right margin. In illustration of the least annual variation, a curve is introduced for the equatorial station of Singapore, at the extremity of the Malay Peninsula, where the mean annual change is only seven degrees (F.); and, in contrast with this torrid uniformity, we find Yakutsk, Siberia, in the so-called temperate zone, giving the greatest known annual variation, on account of being far north, and far within a great continental region. St. Vincent, the coldest of the signal-service stations, is probably our nearest approach to this extreme variability.

The irregularity of the monthly means in different years is shown by short transverse lines above and below the dots: these are farther apart in winter than in summer, on account of the frequency of winter storms which produce great and sudden

changes of temperature.[1] A rough measure of the average daily range for summer and winter is seen in the vertical lines drawn through the July and January dots: these are commonly longer in summer than in winter. The hottest and coldest records for every month are marked by Λ and V.



Denver is thus seen to be warmer but more variable than Pike's Peak. In San Francisco the summer heat extremes rise higher above the mean curve than the winter colds fall below it, while the reverse is the case with New Orleans. The extreme variation between winter minimum and summer maximum, even of different years, is only 23° F. at Singapore: our least variable station is Key West, with a maximum change of 53° F. Yuma, Arizona, although well known as often excessively hot, confines its variations within 93°; Denver has a recorded change of 134° from 105° to —29°; while Fort Benton, Montana, leads the list with a change of 167°, between 108° and — 59°, but even this is exceeded at Yakutsk. The contrast between eastern and western coasts is seen in the variability of Boston as compared with St. Michel, on the coast of France in about the same latitude, the latter being warmer and less variable because it lies to the leeward of a temperate ocean, while Boston is to leeward of an untempered land; and again in comparing Boston (in latitude 42° 21′) with Sitka (in latitude 57° 3′), and recognizing the small difference in their mean temperatures, and the decided decrease in variability, annual and diurnal, in going from the east coast to the west. The effect of going inland is to increase changes of temperature; for, while the sea is conservative of its warmth or cold, the land allows great and rapid variations. If the climatic zones had been first named in this country, ours would never have been called the 'temperate.'

[1] The variation of monthly means for Boston is large, in comparison with that of the other diagrams, partly because it is taken from a thirty-five year record instead of from the eleven or fewer years of the signal-service reports.

THE COMING OF THE ROBIN AND OTHER EARLY BIRDS.

"Hast thou named all the birds without a gun? Loved the wild-rose, and left it on its stalk?"
EMERSON.

THE migration of birds is a subject which is attracting much attention in many parts of the world. From earliest historic times, naturalists and philosophers have written, speculated, and theorized upon the periodic appearance and disappearance of the species with which they were familiar; and the coming and going of many were considered of ominous portent.

In more recent times, ornithologists have watched the movements of birds with increasing interest, and have accurately recorded the facts observed. But it is only within the last few years that any thing like a systematic co-operative attempt to study bird-migration has been made. The work was begun in Germany, and was soon afterwards undertaken in Great Britain. In the United States, co-operative work was commenced in the Mississippi valley in the spring of 1882, under the superintendence of Prof. W. W. Cooke. The investigation of this subject was deemed of such importance that the American ornithologists' union, at its first congress, determined to extend it over the whole of North America, and for this purpose appointed a special committee. This committee prepared a circular (of which six thousand copies were distributed), setting forth the objects in view, and the methods by which they were to be attained. Through the co-operation of the department of marine of Canada, and of the lighthouse boards of the United States and Newfoundland, blank schedules were also supplied to the keepers of lighthouses, lightships, and beacons, throughout the whole of North America. The committee has already received returns from nearly a thousand stations, which are scattered over the whole country, extending, in the east, from Sombrero Key, Fla., to Newfoundland, and, in the west, from Arizona and southern California to British Columbia.

Most birds migrate chiefly by night. In clear weather they fly high, often from one to two miles above the country over which they are passing; while during dark nights, particularly in foggy weather, they often lose the way, become confused, and fly directly toward any light that may chance to lie within the field of vision. Thus, every year many thousands dash themselves to death against lighthouses and lightships. Birds whose summer and winter homes are widely separated often shorten their long journeys by crossing great lakes, broad bays, extensive seas, and sometimes even considerable stretches of open ocean; and observations in various parts of the world, carried on over many years, have demonstrated that the places of crossing are not accidental, but that certain definite courses are followed season after season with surprising regularity and precision. These 'avenues' or 'lines' of migration, though most strongly marked in aquatic, marsh, and river-dwelling species, are not limited to the neighborhood of large bodies of water, but may be traced throughout the entire range of migration. It is also well known that in nearly all birds the same individuals return to identical localities year after year.

The following statement of the times of arrival of the robin (Merula migratoria) at various places will serve to show in a general way the progress of its advance over the greater part of North America during the spring of 1884.[1]

Our common robin winters in vast numbers as far north as North Carolina, and more sparingly in southern New England, New York, and even in southern Ontario north of Lake Erie. On its northward journey, Dr. Wheaton's observers in the middle-eastern district found it at Columbus, O., Feb. 13; Cleveland, O., Feb. 24; Petersburg, Mich., Feb. 19; Battle Creek and Locke, Mich., March 10; Sault St. Marie, April 1. In the Atlantic district, Dr. Fisher's returns show it at Long-Island City, N.Y., Feb. 10; Sing Sing, N.Y., Feb. 14; Lockport, N.Y., Feb. 16; Watertown, N.Y., March 13; Lake George, N.Y., March 20; Hammondville (near Lake Champlain), N.Y., March 24; Boonville, N.Y., March 21; Locust Grove, N.Y., March 25. In Ontario, Mr. McIlwraith reports it at Hamilton, March 17; and at Ottawa, March 14. In New England a few wintered in the southern portions, and their march northward was irregular and often interrupted. Mr. Sage's observers recorded them from East Hartford, Conn., Feb. 2; Greenfield, Mass., Feb. 3; Thetford, Vt., Feb. 22; Hanover, N.H., March 21; Waterborough, Me., March 23; Calais, Me., March 30: Moosehead Lake, Me., April 9. In Quebec and the maritime provinces, Mr. Chamberlain's report shows them at Montreal, March 30; Quebec, April 14; Grand Menan Island, March 10; Halifax, March 18;

[1] These data, by permission of the council of the American ornithologists' union, have been selected from a part of the returns on the species named.

St. John, N.B., March 20; Prince Edward Island, April 15; Godbout, on the north shore of the mouth of the St. Lawrence, May 21; Point Rich, Newfoundland, May 1; and Greenly Island, off Labrador, May 20. In the Mississippi valley, Prof. W. W. Cooke has ascertained that robins usually winter north to about latitude 39°, but that the unusual cold of January, 1884, drove the bulk of them south of the parallel of 37°. Returning, the regular advance began March 9, and in a single week they spread over Illinois and eastern Nebraska to latitude 41° 51′; March 16 there was a slight advance in Iowa; on the 19th and 20th they pushed forward in Iowa, Illinois, and Wisconsin (but not in Nebraska), to latitude 43°; March 21 there was a sudden spreading over Wisconsin to latitude 45°. In the Red-river country, latitude 47° was attained April 3; and one week later the first robin of the season sang at Oak Point, Manitoba, latitude 50° 30′. From Mr. Belding's notes, it appears that the western race of the robin (Merula migratoria propinqua) winters more or less abundantly throughout the greater part of California, moving northward in February, March, and April. Its nest and eggs were found at Seattle, Washington Territory, May 1. In Alaska our robin has been seen in the Chilkat region as early as the end of April, and at Nulato about the middle of May.

The following statement shows approximately the average dates of arrival, in the latitude of New-York City and southern Connecticut, of a number of common and well-known birds. The yearly variation is considerable, and is greatest in the early-comers, amounting in some cases to upwards of two weeks. The robin (Merula migratoria) may be expected about the middle of February; wood-thrush (Turdus mustelinus), first week in May; brown thrasher (Harporhynchus rufus), May 1; catbird (Mimus Carolinensis), May 1; bluebird (Sialia sialis), early in February; house-wren (Troglody tesaedon), May 1; yellow-rumped warbler (Dendroeca coronata), middle of April; barn-swallow (Hirundo erythrogastra horreorum), April 25; scarlet tanager (Pyranga rubra), May 10; red-eyed vireo (Vireo olivaceus), May 6; rose-breasted grosbeak (Zamelodia ludoviciana), May 12; indigo-bird (Passerina cyanea), May 12; chewink (Pipilo erythrophthalmus), May 1; bobolink (Dolichonyx oryzivorus), May 10; red-winged blackbird (Agelaeus phoeniceus), March 1; Baltimore oriole (Icterus galbula), May 8; king-bird (Tyrannus Carolinensis), May 8; pewee (Sayornis fuscus), early March; whippoorwill (Caprimulgus vociferus), May 1; night-hawk (Chordeiles pepetue), May 10; chimney-swift (Chaetura pelasgica), latter part of April; humming-bird (Trochilus colubris), May 5; kingfisher (Ceryle alcyon), flicker (Colaptes auratus), and fish-hawk (Pandion haliaetus Carolinensis), late in March.

TORNADOES, AND HOW TO ESCAPE THEM.

"Blow, winds, and crack your cheeks! Rage! blow!
You cataracts and hurricanoes, spout
Till you have drench'd our steeples, drown'd the cocks!
. . . .
Nay, get thee in. I'll pray, and then I'll sleep."

SHAKSPEARE.

TORNADOES are among the most characteristic features of the central states of the Union. Their opportunity comes when a broad cyclonic disturbance of our regular westerly winds brings cold air of the north-western plains down to meet warm southerly winds from the Gulf of Mexico. A moderate number of miles east of the average contact-lines of these two currents, the tornadoes are formed, when they appear at all. A number of them frequently occur at about the same time, for the contrasts of temperature and moisture that permit the development of one are generally wide-spread enough to produce several more. Fig. 1 illustrates the tracks of the tornadoes of Feb. 19, 1883, when the southern states were swept over by

FIG. 1.

a large number of these storms, — in Kentucky and Alabama about noon, in eastern Alabama and Georgia during the afternoon, and in the Carolinas

after sunset, — the progress of their region of occurrence across the country corresponding to the passage of the broad cyclonic storm that gave them birth. The signal-service report states that about a thousand persons were killed, more than twice as many wounded, and three or four million dollars' worth of property destroyed, by these storms on this single day. This was the first and severest visitation of the year.

The distinguishing mark of the tornado is its dark, pendent funnel-cloud at the centre of the most violent winds. The rules published by the signal-service for escaping from such a storm, when it is seen approaching, are based on the regularity with which tornadoes move to the north-east, or at least to some point between east and north, along a tolerably straight course, at a rate of about thirty

Fig. 2.

miles an hour. If seen to the north-west or south-east, the tornado will, in all probability, pass to one side of the observer. If seen in the south-west, a few moments' watching will serve to discover whether the funnel-cloud is advancing so as to pass north-west or south-east of the observer; then, without waiting too long, let him run to the open side. If the funnel-cloud seems to come directly toward the observer, he should run to the north-west, because the winds on that side are a little less violent than on the other, and the chance of escape there is correspondingly better. In regions where tornadoes occur frequently, every house should be provided with an underground chamber or dug-out, easily reached, and guarded by a strong grated door. This is the only retreat on the storm-path in which safety can be found. The effect of a tornado on the buildings of a western town is seen in fig. 2, copied from a photograph taken by D. H. Cross at Grinnell, Io., shortly after its destruction on June 17, 1882.

BLOOMING-TIMES FOR FLOWERS.

*"And 'tis my faith that every flower
Enjoys the air it breathes."*
Wordsworth.

The pressure brought to bear on every branch of industry in this rapidly moving nineteenth century has not failed to produce its effect on students of natural history; and comparatively few of the present active workers find time to leisurely ramble, observe, and philosophize, as, for example, Gilbert White did a century ago. Yet there is scarcely a lover of nature, however closely confined to his study or laboratory, who does not listen for the first twitter of the bluebird, or delight in the first bunch of violets brought by the spring, and find himself cheered by the chirp of the last robins, and the flowers of the witch-hazel, on the threshold of winter. For such and all lovers of nature, this effort to indicate the usual time at which a few typical plants of the different seasons may fairly be said to be coming into full bloom is made as a reminder of seasons that are gone, and a prompter for those to come.

Like the birds, flowers vary much in their habits. Some stay with us through the entire open season, and push their heads up at the very edge of the snow or in the heat of midsummer; some come at their appointed time, last but a few days or weeks, and disappear completely, be the season what it may; and others, usually regular in their blooming, feel the stimulus of a long, warm autumn, like the last, and anticipate the following spring by unfolding more or less profusely.

Every region has its own climatic peculiarities and its proper spring and autumn; and, though the limits of these may vary somewhat from year to year, there is usually some close observer of nature to be found, who prides himself on knowing a sheltered place where he is certain to find the trailing-arbutus or pasque-flower at about the same

date every year. But one spray of arbutus does not make a spring, and the lovely May-flower may not reach its prime of beauty and fragrance for some time after the most sheltered plants open their buds. Even in the same neighborhood, differences in exposure and elevation defy an exact tabulation of the periods of leafing, flowering, and fruiting; and the moderating influence of a body of water may retard the blooming of early species in its immediate vicinity for days or even weeks.

In a country covering nearly twenty-five degrees of latitude and fifty-five of longitude, with lofty mountains and tablelands and low valleys, diversified by great lakes and rivers, and embracing every variety of climate from the subtropical to the subarctic, with excesses of humidity in one region and of drought in another, it is impossible to arrange the phenomena of the seasons so as to include the whole.

On comparing the data obtainable, however, a few general features are found common to a great part of the country. Whatever their exact date of leafing or flowering may be, there are certain genera — like the maples, poplars, and elms among trees, and the violets and wakerobins among herbs — that precede most of their fellows; and, except in very anomalous seasons, their species succeed each other with the same regularity. Where the same plant extends from the Gulf to New England, it naturally blooms earlier in the warmer region; but it is noticeable that the difference, greatest in the flowers of early spring, becomes less marked as the season advances, under the accelerating heat of the northern summer, so that there is often little difference in the flowering of summer and autumnal plants. In general the same rule applies to species occurring over a considerable range of altitude, and is now and then illustrated nicely by a species with a wide distribution on both high and low ground.

FLORAL CALENDAR.[1]

Blooming all the year in favorable seasons. — Chickweed, dandelion (N.), Cherokee rose (Al.), Eschscholtzia, Anagallis (Cal.).

Jan. 1–10. — Ranunculus californicus (Cal.).

Jan. 10–20. — Ribes sanguineum (Cal.).

Jan. 20–30. — Red cedar (Al.).

Feb. 1–10. — Scoliopus (Cal.), red maple (Al.), Salix scouleriana (O.).

Feb. 10–20. — Trillium ovatum (Cal.), wild plum, trailing-arbutus (Al.).

Feb. 20–28. — Choke-berry, blue violet (Al.), Dentaria (O.).

March 1–10. — Cottonwood, sassafras (Al.), Nemophila Menziesii, Viola pedunculata (Cal.), Trillium ovatum (O.).

March 10–20. — Oaks, Pinus taeda (Al.), Phacelia tanacetifolia, Nemophila aurita (Cal.).

March 20–30. — Locust, flowering dogwood (Al.), Gilia multicaulis (Cal.), Ribes sanguineum (O.).

April 1–10. — Violets, Gilia achilleaefolia (Cal.), magnolia, wild cherry, Oxalis violacea (Al.), skunk-cabbage (N.).

April 10–20. — Gilia androsacea (Cal.), hickories (Al.), red maple, cottonwood, red cedar, pasque-flower (N.), Delphinium bicolor (Col.), Nardosmia palmata (C.), Erythronium (O.).

April 20–30. — Ceanothus thyrsiflorus (Cal.), poison sumach, blue flag (Al.), trailing-arbutus, sugar-maple (N.), Thlaspi alpestre (*Col.*), spring beauty (C.).

May 1–10. — Calochortus alba (Cal.), smooth sumach (Al.), ash, spring beauty, Erythronium, Trillium, golden currant (N.), spring beauty, pasque-flower (Col.), Clematis Douglasii (*Col.*).

May 10–20. — Calochortus Weedii (Cal.), sun-dews, New-Jersey tea (Al.), blue violet, wild plum, wild cherries (N.), Viola Nuttallii (Col.), Mertensia alpina (*Col.*), trailing-arbutus (C.).

May 20–30. — Calochortus pulchella (Cal.), sweet bay, dwarf palmetto (Al.), barberry, oaks, apple (N.), spring beauty (*Col.*), Trillium (C.).

June 1–10. — Lilium pardalinum (Cal.), St. Johns worts (Al.), blue flag, choke-berry (N.), Sophora sericea (Col.), golden currant (*Col.*), Calypso (C.).

June 10–20. — Mentzelia laevicaulis (Cal.), Virginia-creeper (Al.), raspberry, locust (N.), Lepachys columnaris (Col.), Anemone multifida (*Col.*).

June 20–30. — Rosa carolina (Al.), laurel, sun-dews, Aquilegia coerulea (N.), Delphinium azureum, Gilia aggregata (Col.), Zygadenus glaucus (*Col.*), Cypripedium acaule (C.).

July 1–10. — Sabbatia, Aster paludosus (Al.), Virginia-creeper, Rosa carolina (N.), Cleome integrifolia (Col.), pasque-flower (*Col.*).

July 10–20. — Gentiana oregana (Cal.), Habenaria ciliaris (Al.), New-Jersey tea, smooth sumach (N.), Pentstemon glabra (Col.), Gilia aggregata, Viola canina (*Col.*), Habenaria psycodes (C.).

[1] Based on the notes of Dr. Mohr for Mobile, Ala. (Al.); Professor Porter for middle Colorado (3–6,000 feet, Col.; 8–10,000 feet, *Col.*); Mr. Rattan for San Francisco, Cal. (Cal.); Mr. Hay for St. John, N.B. (C.); Mr. Howell for Oregon (O.); and the writer for Wisconsin and New York (N.).

July 20–30. — Rhexia, Zygadenus (Al.), poison sumach (N.), Grindelia squarrosa (Col.), Aquilegia coerulea (*Col.*), Lilium canadense (C.).

Aug. 1–10. — Zauschneria (Cal.), Petalostemon corymbosum (Al.), Sabbatia, Habenaria ciliaris (N.), Helianthus petiolaris (Col.), Erythronium grandiflorum (*Col.*), Rubus villosus (C).

Aug. 10–20. — Chrysolepis mariana (Al.), sun-flowers (N.), Malvastrum coccineum (Col.), Aster canescens (*Col.*), lovage (C.).

Aug. 20–30. — Lilium catesbaei, Liatris elegans (Al.), Solidago altissima (N.), Solidago missouriensis (Col.), Gentiana Parryi (*Col.*), Impatiens (C.), Aster Douglasii (O.).

Sept. 1–10. — Nabalus Frazeri (Al.), beech-drops, Liatris, Indian pipe (N.), Aster spectabilis (C.), golden-rods (O.).

Sept. 10–20. — Golden-rods (Al.), golden-rods, sow-thistle, Nabalus Frazeri (N.) (C.).

Sept. 20–30. — Gerardia purpurea (Al.), gentians, Acalypha (N.).

Oct. 1–10. — Aster tradescanti (Al.), asters (N.).

Oct. 10–20. — Gentiana ochroleuca (Al.).

Oct. 20–30. — Gentiana elliotii (Al.).

Nov. — Spiranthes brevifolia (Al.), witch-hazel (N.).

IMPORTANT AGRICULTURAL STATISTICS.

Live-stock in the United States in 1880, excluding ranch-stock, horses, mules, cows, and swine in cities, and those belonging to persons not owning or occupying farms.

Horses	10,357,981	Sheep	35,191,656
Cows (milch)	12,443,593	Swine	47,687,951
Other cattle	22,488,590		

The leading states in the raising of live-stock are as follows.

Illinois, horses	1,023,082
New York, milch-cows	1,437,855
Texas, other cattle	3,387,967
Ohio, sheep	4,902,486
Iowa, swine	6,034,316

Average yield per acre of cereals in the United States, 1880.

	Bush.		*Bush.*
Indian corn	28+	Barley	22+
Wheat	13–	Rye	10+
Oats	25+	Buckwheat	14–

Cereals raised in the United States in 1880.

	Bush.		*Bush.*
Indian corn	1,754,861,535	Barley	44,113,495
Wheat	559,479,505	Rye	19,831,595
Oats	407,858,999	Buckwheat	11,817,327

The leading states in the production of cereals.

	Bush.		*Bush.*
Illinois, Indian corn	325,793,481	Iowa, oats	50,610,591
Iowa, Indian corn	275,024,247	New York, oats	37,575,506
Missouri, Ind'n corn	202,485,721	Pennsylvania, oats	33,841,439
Indiana, Indian corn	115,482,300	Wisconsin, oats	32,905,320
Ohio, Indian corn	111,877,124	California, barley	12,579,561
Kansas, Indian corn	105,729,325	Wisconsin, barley	5,043,118
Illinois, wheat	51,110,503	Pennsylvania, rye	3,683,621
Indiana, wheat	47,284,855	Illinois, rye	3,121,785
Ohio, wheat	46,014,869	New York, rye	2,634,690
Michigan, wheat	35,532,543	Wisconsin, rye	2,298,513
Minnesota, wheat	34,601,030	New York, buckwheat	4,461,200
Iowa, wheat	31,154,205	Pennsylvania, buckwheat	3,573,326
California, wheat	29,017,707		
Illinois, oats	63,189,200		

Average yield of corn and wheat per acre (in bushels).

	Corn.	*Wheat.*
Alabama	12+	6–
California	27+	15+
Massachusetts	35+	16+
New York	33+	15+
Illinois	36+	16–
Pennsylvania	33–	13+
Florida	9–	5+
Georgia	9+	7–
Minnesota	33+	11+

Implements and workmen.

Agricultural implements, number and value (1880).

Number of establishments	1,943
Number of hands employed	39,580
Capital invested	$62,109,668
Wages of workmen	15,359,610
Value of material	31,531,170
Value of implements manufactured	68,640,486
Number of reapers and mowers manufactured	162,337
Number of grain-cradles manufactured	167,492
Number of scythes manufactured	1,244,264
Number of horse-rakes manufactured	95,625

Farms.

Number of farms in the United States in 1880, 4,008,907.

States then having 200,000 and upwards.

Illinois	255,741	Missouri	215,575
Ohio	247,189	Pennsylvania	213,541
New York	241,058		

Cotton raised in 1880.

Total in the United States, 5,735,257 bales of 475 pounds each.

States producing 500,000 bales and upwards.

	Bales.		*Bales.*
Mississippi	955,808	Arkansas	608,256
Georgia	814,441	South Carolina	522,548
Texas	803,642	Louisiana	508,569
Alabama	699,654		

The extremes of production are Missouri, $\frac{60}{100}$ of a bale; Florida, $\frac{22}{100}$ per acre.

A FEW PERTINENT HINTS TO FARMERS.

Fences and farm-buildings.

SEASON fence-posts one year before using. Cut oak and cedar in February, chestnut and most other woods in August. To insure durability, soak the lower ends of posts in brine before setting. In the east the cost of fencing is equal to the value of the live-stock. To tear down a fence without splitting the boards, strike the side of the post near the top a sharp blow, in line with the fence, with a heavy sledge-hammer. To drive nails into very hard wood, dip their points in oil. Use steel nails for fencing. Paint in cool, cloudy weather. Use little lead and much oil for first coat. It does not pay to paint barns which are boarded vertically. Lime will remove moss from roofs.

Care of cattle.

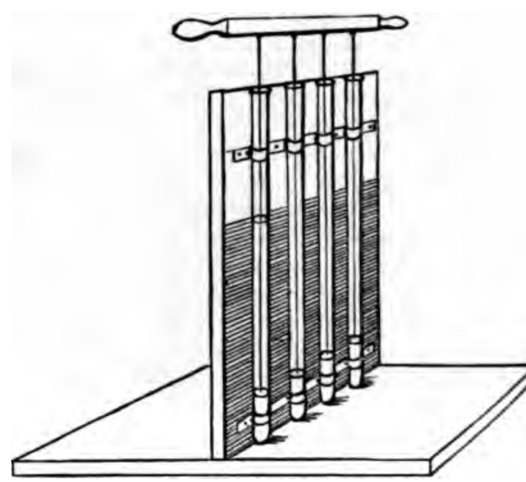
Try standing and lying on a hard plank floor twenty-three consecutive hours, and you will use the stanchions for kindlings, and build a covered barnyard. Feed cattle but twice daily, always before milking: give water as often, at a temperature of 55°; it is safer to scrimp food than water. Meal, if fed alone, especially to young calves, should be spread thinly on the bottom of troughs, so that it will be eaten slowly, and be insalivated. Allow one cubic foot of air-space for each pound of live weight. Temperature of cow-stables should range from 45° to 55°.

Hints on breeding.

Keep a mature thoroughbred bull at the head of the herd. Use selected common cows. Raise all female calves, and as many males as circumstances will admit, except badly marked or weak ones and those from two-year-old heifers. Uniformity in color, shape, and general characteristics, adds much to beauty and value. Heifers tried two years, if not satisfactory, should be fattened and sent to the shambles. Weigh the milk of each cow at least one day in each week. Stop guessing, and get facts. Selection, food, and care are the three great elements of success and improvement. Boys and cattle should be raised on the farm, not in the city.

Suggestions about dairying.

Procure a number of glass tubes, sixteen inches long, one inch in diameter, and closed at one end. With two strips of leather and tacks, fasten them upon a board two feet long and sixteen inches wide. Place under them a paper ten inches wide, ruled with lines a tenth of an inch apart. Fill each tube to the depth of ten inches with one cow's milk. The lines will designate the per cent of cream. Provide a metal dasher for each tube, and attach the handles of them to a common horizontal handle. Churn all the milk in the tubes at one operation, and note the per cent of butter in each tube. By this method it was proved, that, while one cow produced a hundred and eighty dollars' worth of milk in a year, another produced only forty dollars' worth. Nitrogenous foods,



A CREAM-TESTER.

such as cottonseed-meal and clover-hay, tend to produce large quantities of milk, the butter from which is inclined to be oily. Heat-producing foods, such as corn-meal, do not tend to largely increase the flow of milk, but to improve the quality and quantity of the butter. Animals part with the fat of the body more easily than they extract fat from their food: hence it is economy to moderately fatten the cow when dry. Sweet skimmed milk is worth, to feed in connection with other food to a good breed of pigs, one cent per quart. Two quarts of milk drawn from the cow by the calf is worth three quarts fed to it from a pail. Calves are more cheaply raised in winter than in summer.

A few facts about manures.

The value of the manure of a thousand-pound cow, liberally fed, ranges from five to ten cents per day, exclusive of bedding. Milch-cows take from their food about twenty per cent of its manurial value; fattening stock, about five per cent; young animals and dry cows, ten per cent.

CHRONOLOGICAL CYCLES, 1885.

Dominical letter	D
Epact	14
Lunar cycle or Golden number	5
Solar cycle	18
Roman indiction	13
Julian period	6598

FIXED AND MOVABLE FESTIVALS OF THE CHURCH, 1885.

Epiphany	Jan. 6.
Septuagesima Sunday	Feb. 1.
Quinquagesima (Shrove Sunday)	Feb. 15.
Ash Wednesday	Feb. 18.
First Sunday in Lent	Feb. 22.
St. Patrick	March 17.
Palm Sunday	March 29.
Good Friday	April 3.
Easter Sunday	April 5.
Low Sunday	April 12.
Rogation Sunday	May 10.
Ascension Day (Holy Thursday)	May 14.
Pentecost (Whit Sunday)	May 24.
Trinity Sunday	May 31.
Corpus Christi	June 4.
St. John Baptist (Midsummer Day)	June 24.
Michaelmas Day	Sept. 29.
First Sunday in Advent	Nov. 29.
Christmas Day	Dec. 25.

MORNING AND EVENING STARS, 1885.

MERCURY will be visible as morning-star about Jan. 26, May 25, and Sept. 15; and as evening-star about April 8, Aug. 6, and Nov. 30.

VENUS will be morning-star till May 4, then evening-star the rest of the year.

MARS will be evening-star till Feb. 11, then morning-star the rest of the year.

JUPITER will be morning-star till Feb. 18, then evening-star till Sept. 8, and morning-star again the rest of the year.

SATURN will be evening-star till June 18, then morning-star till Dec. 26, and evening-star again the rest of the year.

SEASONS, 1885.

(Eastern standard.)

Spring begins	March 20, 5^h A.M.
Summer "	June 21, 2^h A.M.
Autumn "	Sept. 22, 4^h P.M.
Winter "	Dec. 21, 10^h A.M.

TIDE TABLE.

THE table of tides is limited to points on the Atlantic coast, as the tides on the Pacific coast are of so complicated a character that it would be impossible to refer to them by the simple table of reduction as given. The actual times of the occurrence of high and low water are much affected by the force of the wind, a difference of fifteen minutes between prediction and observation often being brought about.

Intervals to be applied to the standard time of high water at New York, found in the calendar pages.	Correction to New-York (standard time) tide to obtain tide in standard time elsewhere.			Mean range.
		H.	M.	FEET.
Eastport, Me.	Add	3	33	18.2
Mount Desert Island, Me.	"	2	32	9.9
Belfast, Me.	"	2	38	9.7
Portland, Me.	"	2	55	9.1
Portsmouth, N.H.	"	3	3	8.6
Newburyport, Mass.	"	3	17	7.5
Ipswich, Mass.	"	3	6	9.0
Rockport, Mass.	"	2	36	8.6
Gloucester, Mass.	"	2	44	8.9
Marblehead, Mass.	"	2	51	9.3
Salem, Mass.	"	2	54	9.2
Plymouth, Mass.	"	2	59	10.2
Provincetown, Mass.	"	2	59	9.2
Hyannis, Mass.	"	4	0	3.3
Nantucket, Mass.	"	4	15	3.0
Vineyard Haven, Mass.	"	3	22	1.6
Wood's Holl (north side), Mass.	Sub.	0	21	4.0
Wood's Holl (south side), Mass.	Add	0	14	1.6
New Bedford entrance (Dumpling R.), Mass.	Sub.	0	20	3.7
Fall River, Mass.	"	0	8	4.7
Newport, R.I.	"	0	33	3.9
Point Judith, R.I.	"	0	45	3.1
Montauk Point, R.I.	Add	0	4	1.9
Watch Hill, R.I.	"	0	44	2.7
Stonington, Conn.	"	0	52	2.7
New London, Conn.	"	1	12	2.5
Norwich, Conn.	"	1	57	3.1
New Haven, Conn.	"	2	57	6.0
Bridgeport, Conn.	"	3	1	6.5
New Rochelle, N.Y.	"	3	14	7.6
West Point, N.Y.	"	2	55	2.7
Albany and Greenbush, N.Y.	Sub.	2	48	2.3
Brooklyn (navy-yard), N.Y.	Add	0	47	4.4
Newark, N.J.	"	0	46	5.0
Sandy Hook, N.J.	Sub.	0	36	4.7
Barnegat, N.J.	Add	1	38	0.9
Cape May Landing, N.J.	"	0	16	4.8
Delaware Breakwater, Del.	Sub.	0	3	3.5
Delaware City, Del.	Add	2	59	6.3
New Castle, Del.	"	3	52	6.5
Philadelphia, Penn.	"	5	42	6.0
Annapolis, Md.	Sub.	3	19	0.9
Baltimore, Md.	"	1	24	1.3
Havre de Grace, Md.	Add	1	38	1.5
Point Lookout, Md.	"	4	58	1.4
Washington (Long Bridge), D.C.	Sub.	0	20	2.8
Norfolk (navy-yard), Va.	Add	1	5	2.7
Richmond, Va.	Sub.	3	25	3.6
Hatteras Inlet, N.C.	"	0	56	2.0
Beaufort, N.C.	"	0	35	2.8
Wilmington, N.C.	Add	1	15	2.7
Smithville, N.C.	Sub.	0	35	4.4
Charleston (new Custom-House wharf), S.C.	"	0	19	5.1
Beaufort, S.C.	"	0	42	7.3
Savannah (dry dock), Ga.	"	0	25	6.5
Fernandina, Fla.	"	0	44	6.1
St. John's River (entrance), Fla.	"	1	1	5.3
St. Augustine, Fla.	"	0	17	4.1
Cape Florida, Fla.	"	0	9	1.3
Key West, Fla.	Add	1	4	1.2
Cedar Keys, Fla.	"	4	52	1.9

ECLIPSES, 1885.

In the year 1885 there will be four eclipses, — two of the sun, and two of the moon.

I. An annular eclipse of the sun, March 16; visible in North America generally as a partial eclipse, — being annular within a belt 35 miles wide, drawn through Weaverville and Fort Bidwell, Cal.; Idaho and Boise Cities, Idaho; Bannack City and Gallatin, Montana; Hudson Bay and Greenland, — occurring as follows: —

STANDARD TIME:	Begins.	Ends.	Annular.
	H. M.	H. M.	H. M.
Bangor, Me.	0 23 A.	2 58 A.	- -
Boston, Mass.	0 20 A.	2 53 A.	- -
New York, N.Y.	0 13 A.	2 46 A.	- -
Philadelphia, Penn.	0 10 A.	2 43 A.	- -
Buffalo, N.Y.	0 2 A.	2 42 A.	- -
Pittsburg, Penn.	11 58 M.	2 38 A.	- -
Cincinnati, O.	10 48 M.	1 29 A.	- -
Chicago, Ill.	10 45 M.	1 30 A.	- -
Nashville, Tenn.	10 41 M.	1 22 A.	- -
St. Louis, Mo.	10 37 M.	1 20 A.	- -
Omaha, Neb.	10 28 M.	1 15 A.	- -
Baltimore, Md.	0 7 A.	2 40 A.	- -
Washington, D.C.	0 6 A.	2 39 A.	- -
Charleston, S.C.	11 57 M.	2 24 A.	-
Savannah, Ga.	10 54 M.	1 21 A.	- -
Jacksonville, Fla.	10 53 M.	1 17 A.	- -
Raleigh, N.C.	0 0 A.	2 31 A.	- -
Mobile, Ala.	10 33 M.	1 11 A.	- -
New Orleans, La.	10 28 M.	1 8 A.	- -
Memphis, Tenn.	10 33 M.	1 15 A.	- -
Galveston, Tex.	10 15 M.	1 0 A.	- -
St. Paul, Minn.	10 38 M.	1 25 A.	- -
Denver, Col.	9 10 M.	0 1 A.	- -
Salt Lake City, Utah	9 3 M.	11 52 M.	- -
Santa Fé, N. Mex.	9 3 M.	11 53 M.	- -
San Francisco, Cal.	7 48 M.	10 30 M.	- -
Portland, Ore.	8 2 M.	10 41 M.	- -
Boise City, Idaho	9 3 M.	11 49 M.	10 23 M.
Bannack, Montana	9 8 M.	11 57 M.	10 30 M.
Weaverville, Cal.	7 52 M.	10 33 M.	9 8 M.
Fort Bidwell, Cal.	7 57 M.	10 39 M.	9 14 M.

Duration of annulus, from $\frac{1}{2}$ to $\frac{3}{4}$ of a minute.

II. A partial eclipse of the moon, March 30; invisible in America; visible in Asia, Australia, eastern portions of Europe and Africa, and the western Pacific Ocean.

III. A total eclipse of the sun, Sept. 8; invisible in North America; visible chiefly in the South Pacific Ocean.

IV. A partial eclipse of the moon, Sept. 23, 24; visible in North and South America and the Atlantic and Pacific Oceans, happening as follows: —

STANDARD TIME:	Eastern.	Central.	Mountain.	Pacific.
	D. H. M.	D. H. M.	D. H. M.	D. H. M.
Moon enters penumbra	24 0 0 M.	23 11 0 A.	23 10 0 A.	23 9 0 A.
Moon enters shadow	24 1 14 M.	24 0 14 M.	23 11 14 A.	23 10 14 A.
Middle of the eclipse	24 2 48 M.	24 1 48 M.	24 0 48 M.	23 11 48 A.
Moon leaves shadow	24 4 22 M.	24 3 22 M.	24 2 22 M.	24 1 22 M.
Moon leaves penumbra	24 5 36 M.	24 4 36 M.	24 3 36 M.	24 2 36 M.

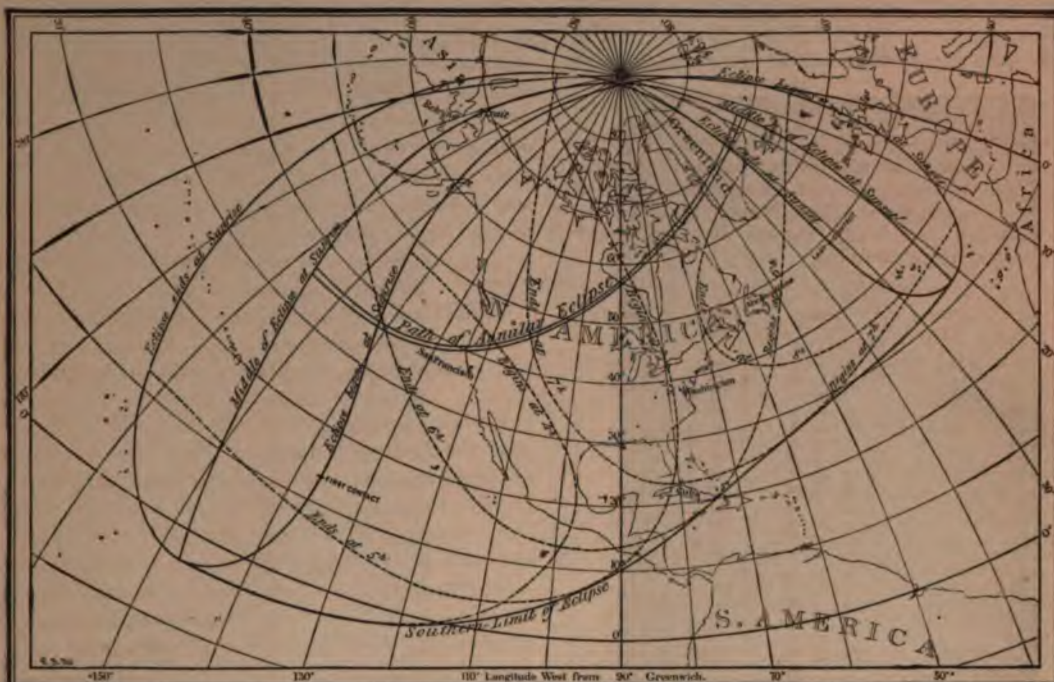
Magnitude of eclipse = 0.79 (moon's diameter = 1).

SYMBOLS.

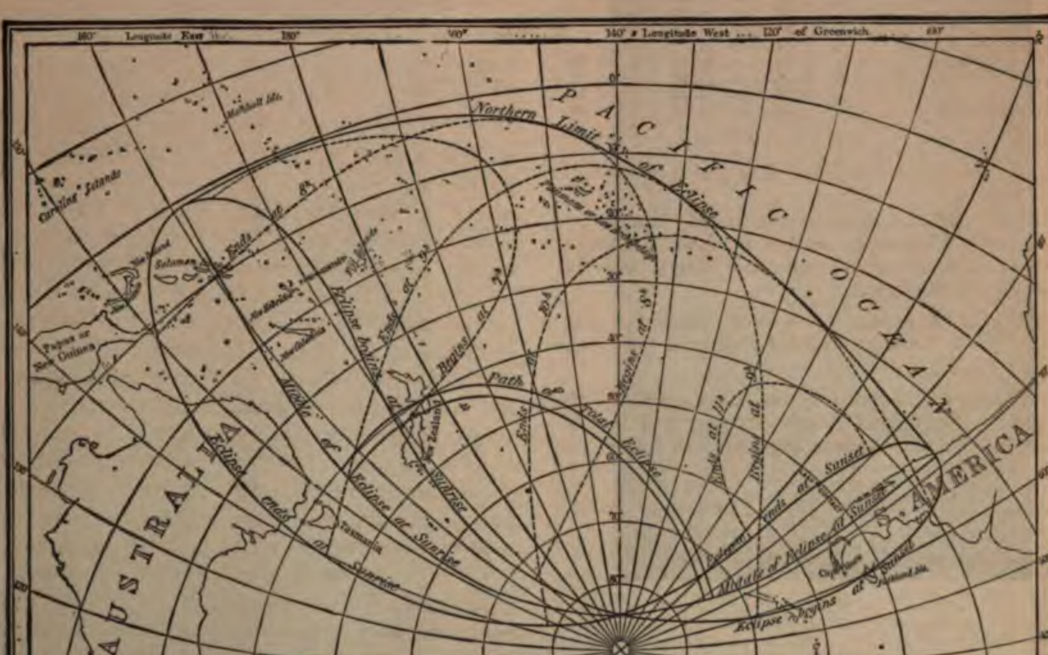
☉ . . . The Sun.
☾ . . . The Moon.
☿ . . . Mercury.
♀ . . . Venus.
⊕ . . . The Earth.
♂ . . . Mars.
♃ . . . Jupiter.
♄ . . . Saturn.
♅ . . . Uranus.
♆ . . . Neptune.
⌒ . . . Moon runs high.
⌣ . . . Moon runs low.
☌ . . . Conjunction, or having the same longitude or right ascension.
□ . . . Quadrature, or differing 90° in longitude or right ascension.
☍ . . . Opposition, or differing 180° in longitude or right ascension.
☊ . . . Ascending node.
☋ . . . Descending node.
S . . . Appended to the stars, 'souths,' or crosses the meridian.
♈ . . . Aries.
♉ . . . Taurus.
♊ . . . Gemini.
♋ . . . Cancer.
♌ . . . Leo.
♍ . . . Virgo.
♎ . . . Libra.
♏ . . . Scorpio.
♐ . . . Sagittarius.
♑ . . . Capricornus.
♒ . . . Aquarius.
♓ . . . Pisces.

SUN-TIME AND CLOCK-TIME.

One very often hears some friend say, when extolling the merits of his watch, that he sets the sun by it. It is doubtless supposed by many that the sun is most regular in its habits, and crosses the meridian exactly at noon; and it was with a feeling of regret at parting company with a so-supposed faithful time-keeper, that many set their watches to standard time on the 19th of November, 1883. If the orbit of the earth were perfectly circular, and the sun revolved around an axis perpendicular to the plane of the orbit, then the sun would have the reliable character with which it is now credited; but, unfortunately, the orbit is not circular, and the earth revolves about an axis inclined to the plane of the orbit, so that the apparent motion of the sun varies in rate from time to time through the year. And as it is convenient for us to have our days of equal length, the mean time to which we set our clocks differs from solar time by as much as fifteen minutes on the 10th of February, and fully sixteen minutes on the 27th of October. The relation between mean time (the time we use on our clocks and watches) and solar or apparent time (that of the sun-dial) is readily



ANNULAR SOLAR ECLIPSE OF MARCH 16, 1885.



TOTAL SOLAR ECLIPSE OF SEPTEMBER 8, 1885.

seen from the accompanying diagram; and what is meant by the equation of time, which is nothing more than the difference between mean time and

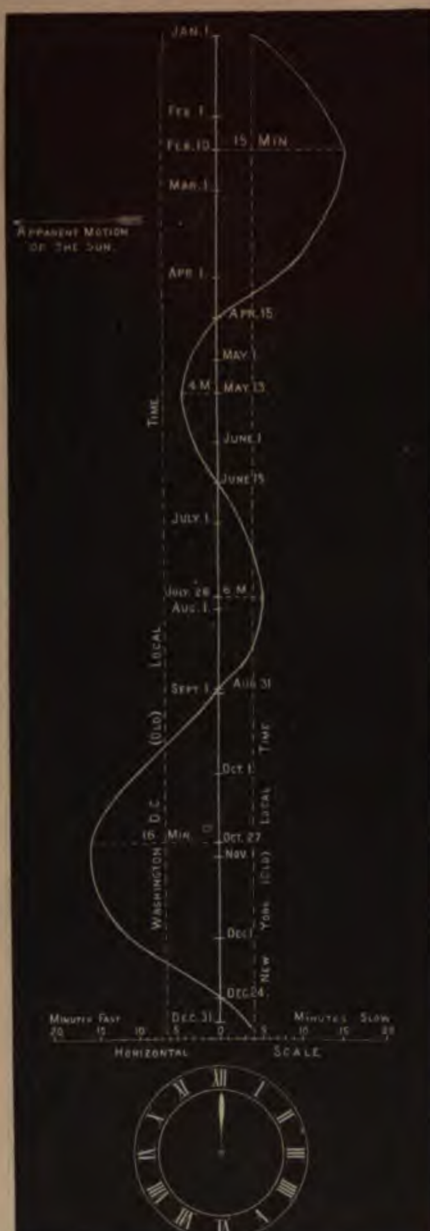


DIAGRAM SHOWING COMPARISON OF MEAN (OR CLOCK) TIME WITH SOLAR (OR APPARENT) TIME AT THE SEVERAL SEASONS OF THE YEAR. THE PERPENDICULAR CENTRAL LINE REPRESENTS MEAN TIME, AND THE CURVED LINE SOLAR TIME, AT MEAN NOON. (Borrowed, by permission, from the *Popular science monthly*.)

solar time, may be seen by a glance, and is given by the length of a horizontal line running from the vertical line through the zero of the scale, to a point on the curve corresponding to the date for which the equation of time is desired. For all ordinary purposes, the diagram is sufficiently accurate; although, of course, it has not all the refinements which might be suggested, as, in fact, a single diagram could not be given for all years.

NEW MAPS OF THE HEAVENS.

> "*Nature and Nature's laws lay hid in night.*
> *God said, 'Let Newton be!' and all was light.*"
>
> POPE.

THE accompanying maps represent the heavens from the north pole to 30° south of the equator, and include all stars to the $4\frac{3}{4}$ magnitude inclusive. In some instances those of the $4\frac{1}{2}$ magnitude have been incorporated for the sake of configuration and convenience of identification.

The maps also include portions of the milky way, the paths of the planets during the year, with their location in these paths at certain definite intervals. From these the position of any planet for any date can be obtained with sufficient accuracy for finding-purposes.

The numbers around the circumference of the circular map, and at the top and bottom of the rectangular maps, indicate hours of right ascension; and the other figures along the line of 0 and 12 hours, every ten degrees of declination. The curving line represents the ecliptic or apparent path of the sun in the heavens.

The months at the borders indicate the part of the heavens that would be on the meridian at nine o'clock in the evening at the various times expressed. Thus, on Jan. 1, the stars along the line of 3.7 hours would be crossing the meridian at nine o'clock in the evening, and on Feb. 1 those on the meridian of 5.8 hours, etc.

RATES OF DOMESTIC POSTAGE.

Letters and all other written matter, whether sealed or unsealed, and all other matter sealed, nailed, sewed, tied, or fastened in any manner, so that it cannot be easily examined, per half-ounce, or fraction thereof, 2 cents; *postal-cards*, each 1 cent; *printed matter* (except newspapers and periodicals), in unsealed wrappers only, each two ounces, or fraction thereof, 1 cent (limit of weight four pounds, except for a single book, which may weigh more; prepayment compulsory); *newspapers and periodicals*, in unsealed wrappers, each four ounces, or fraction thereof, 1 cent; mailable *merchandise*, in packages easily opened for examination, per ounce, or fraction thereof, 1 cent (limit of weight four pounds; prepayment compulsory); registration-fee on letters or other articles, 10 cents.

URSA MAJOR
XI
X
Apr. 1
IX
VIII
LYNX
Mar. 1
Castor
GEMINI
VII
AURIGA
VI
Feb. 1
1st Magnitude
2d do
3d do
4th do

STANDARD TIME.

For the convenience of the travelling public, there have been adopted by the railroads of the United States and the Dominion of Canada, and to a certain extent by the municipalities of the two countries, five different standards of time, extending from Nova Scotia to the Pacific coast, being as follows: —

Name.	Central meridian.
Intercolonial	$60° = 4^h$ west from Greenwich.
Eastern	$75° = 5^h$ " " "
Central	$90° = 6^h$ " " "
Mountain	$105° = 7^h$ " " "
Pacific	$120° = 8^h$ " " "

The calculations of this almanac are given in ***local mean time***, except where otherwise stated. To change to 'standard time,' apply a ***plus*** or ***minus*** correction, to be found by subtracting the central longitude of the adopted standard from the longitude of the place, reduced to time.

For example: the standard of Boston is the 'Eastern' one, carrying (as per schedule above) the longitude of 75°, or 5 hours, which, subtracted from Boston's longitude, $71° 4' = 4^h 44^m$, gives a ***minus*** result of 3° 56′, or 16 minutes, to be ***subtracted*** from the printed mean-time values for Boston.

Again: the standard for St. Paul — the 'Central' one — is 6 hours, which, subtracted from St. Paul's longitude of $6^h 12^m$, leaves a correction of 12 minutes to be ***added***, in order to change to St. Paul's standard.

The following table gives the correction for a number of the principal cities of the continent: —

STANDARD TIME-TABLE.

Correction to be applied to local mean time to obtain standard time.

	Standard.	Correction.		Standard.	Correction.		Standard.	Correction.
		M.			M.			M.
Eastport, Me.	Intercolonial.	+ 28	Erie, Penn.	Central.	− 40	Jacksonville, Fla.	Central.	− 35
Bangor, Me.	Eastern.	− 25	Cleveland, O.	"	− 33	Pensacola, Fla.	"	− 11
Augusta, Me.	"	− 21	Columbus, O.	"	− 28	Lexington, Ky.	"	− 23
Portland, Me.	"	− 19	Toledo, O.	"	− 26	Louisville, Ky.	"	− 18
Concord, N.H.	"	− 14	Cincinnati, O.	"	− 22	Knoxville, Tenn.	"	− 24
Manchester, N.H.	"	− 14	Detroit, Mich.	"	− 28	Nashville, Tenn.	"	− 13
Montpelier, Vt.	"	− 10	Lansing, Mich.	"	− 22	Memphis, Tenn.	"	−
Burlington, Vt.	"	− 7	Grand Haven, Mich.	"	− 15	Montgomery, Ala.	"	− 15
Boston, Mass.	"	− 16	Fort Wayne, Ind.	"	− 19	Huntsville, Ala.	"	− 13
Springfield, Mass.	"	− 10	Indianapolis, Ind.	"	− 16	Mobile, Ala.	"	− 8
Northampton, Mass.	"	− 9	Chicago, Ill.	"	− 10	Holly Springs, Miss.	"	− 2
Newport, R.I.	"	− 15	Cairo, Ill.	"	− 3	Jackson, Miss.	"	+ 1
Providence, R.I.	"	− 14	Springfield, Ill.	"	− 2	New Orleans, La.	"	−
Hartford, Conn.	"	− 9	Galena, Ill.	"	+ 2	Shreveport, La.	"	+ 15
New Haven, Conn.	"	− 8	Quincy, Ill.	"	+ 6	Little Rock, Ark.	"	+ 9
Albany, N.Y.	"	− 5	Milwaukee, Wis.	"	− 8	Fort Gibson, Ind. Ter.	"	+ 21
New York, N.Y.	"	− 4	Janesville, Wis.	"	− 4	Galveston, Tex.	"	+ 19
Utica, N.Y.	"	+ 1	Madison, Wis.	"	− 3	Houston, Tex	"	+ 21
Syracuse, N.Y.	"	+ 5	Superior City, Wis.	"	+ 8	Dallas, Tex.	"	+ 27
Rochester, N.Y.	"	+ 11	Dubuque, Io.	"	+ 3	Austin, Tex.	"	+ 31
Buffalo, N.Y.	"	+ 16	Davenport, Io.	"	+ 3	San Antonio, Tex.	"	+ 34
Newark, N.J.	"	− 3	Des Moines, Io.	"	+ 14	Cheyenne, Wyoming.	Mountain.	− 1
Trenton, N.J.	"	− 1	Duluth, Minn.	"	+ 9	Denver, Col.	"	−
Philadelphia, Penn.	"	+ 1	St. Paul, Minn.	"	+ 12	Santa Fé, N. Mex.	"	+ 4
Harrisburg, Penn.	"	+ 7	Minneapolis, Minn.	"	+ 13	Helena, Montana	"	+ 28
Pittsburg, Penn.	"	+ 20	St. Louis, Mo.	"	+ 1	Salt Lake City, Utah	"	+ 28
Wilmington, Del.	"	+ 2	Jefferson City, Mo.	"	+ 9	Virginia City, Nev.	Pacific.	− 2
Baltimore, Md.	"	+ 6	Kansas City, Mo.	"	+ 18	San Diego, Cal.	"	− 11
Washington, D.C.	"	+ 8	St. Joseph, Mo.	"	+ 19	Sacramento, Cal.	"	+ 6
Norfolk, Va.	"	+ 5	Lawrence, Kan.	"	+ 21	San Francisco, Cal.	"	+ 10
Richmond, Va.	"	+ 10	Topeka, Kan.	"	+ 23	Olympia, Wash. Ter.	"	+ 11
Lynchburg, Va.	"	+ 17	Omaha, Neb.	"	+ 24	Portland, Ore.	"	− 11
Wheeling, W. Va.	"	+ 23	Lincoln, Neb.	"	+ 27		"	−
Wilmington, N.C.	"	+ 12	Yankton, Dakota	"	+ 29	Quebec, Quebec	Eastern.	− 15
Raleigh, N.C.	"	+ 15	Bismark, Dakota	"	+ 43	Montreal, Quebec	"	0
Charleston, S.C.	"	+ 20	Savannah, Ga.	"	− 36	Ottawa, Ontario	"	+ 3
Columbia, S.C.	"	+ 24	Milledgeville, Ga.	"	− 27	Toronto, Ontario	"	+ 18

THE SUN AND THE PLANETS, THEIR COMPARATIVE DIMENSIONS.

THE accompanying illustration (borrowed from Guillemin's 'Le ciel') shows at a glance the relative size of the sun and planets. The sun is represented in an abnormally spotted condition, it being doubtful whether he ever displays so pitted a face. The small planets, or asteroids, one or more of which are discovered each month, could not be represented on so small a scale, as they would be invisible, the actual diameters of some not being more than a few miles. The overwhelming size of the sun is well brought out; its volume is six hundred times that of all the planets; and, if placed in a balance, it would outweigh seven hundred and forty times their total mass. The following table shows the relative masses and densities of the planets:—

PLANETS.	MASS.	DENSITY.	PLANETS.	MASS.	DENSITY.	PLANETS.	MASS.	DENSITY.	PLANETS.	MASS.	DENSITY.
Mercury	0.075	1.376	Earth	1.000	1.000	Jupiter	309.028	0.243	Uranus	18.542	0.220
Venus	0.787	0.905	Mars	0.109	0.692	Saturn	92.394	0.133	Neptune	15.771	0.221

MAP OF THE SOLAR SYSTEM.

THE orbits of the five inner planets and of many of the periodic comets are given in the accompanying diagram, which is drawn approximately to scale, the orbits of the satellites being enlarged to prevent confusion. Saturn would appear at a distance of 3.62 inches from the sun, if its orbit were drawn on the same scale, Uranus at a distance of 7.29 inches, and Neptune at a distance of 12.28 inches. The shaded portion indicates the region within which the asteroids, or smaller planets, are found; and the orbit of the largest of these, and those longest known, — Vesta, Ceres, Pallas, and Juno, — are given. The earth has one moon; Mars, two; Jupiter, four; Saturn, eight; Uranus, four; and Neptune, one. Ceres, the first asteroid, was found in 1801, Pallas in 1802, Juno in 1804, and Vesta in 1807. The first asteroids discovered ranged between 300 and 600 kilometres in diameter; while the smaller ones, which have been more recently found, often are not more than from 20 to 50 kilometres in diameter (10 to 25 miles). The distance of the sun from the earth is said to be 92,500,000 miles; and the distance of the nearest fixed star, if given on the same scale as the diagram, would be 78,000 inches (about a mile and a quarter).

"When icicles hang by the wall,
And Dick the shepherd blows his nail,
And Tom bears logs into the hall,
And milk comes frozen home in pail" — SHAKSPEARE.

JANUARY, 1885.

"*Announced by all the trumpets of the sky,*
Arrives the snow, and, driving o'er the fields,
Seems nowhere to alight. . . . The housemates sit
Around the radiant fireplace, enclosed
In a tumultuous privacy of storm." EMERSON.

Mean time is used unless otherwise specified.

First Month. 31 Days.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time.) Morn. H. M.	High Water, New York (Standard Time.) Eve. H. M.
1	1	Th.	♊	○ 1st. Algenib s. 5.20 A.	7 30	4 39	5 41	7 19	4 49	5 50	7 3	5 6	6 2	7 53	8 35
2	2	Fr.	♋	Venus rises 5.8 M.	7 30	4 40	6 52	7 19	4 50	6 59	7 3	5 7	7 10	8 43	9 21
3	3	Sa.	♋	☌ ☿ ⊙ inferior.	7 30	4 41	8 2	7 19	4 51	8 8	7 3	5 7	8 16	9 32	10 14
1. Sunday after New Year.				Day's Length:		9h. 12m.			9h. 33m.			10h. 5m.			
4	4	Su.	♌	☌ ♃ ☾.	7 30	4 42	9 11	7 19	4 52	9 15	7 3	5 8	9 19	10 21	11 8
5	5	M.	♌	Polaris s. 6.18 A.	7 30	4 43	10 18	7 19	4 53	10 20	7 4	5 9	10 21	11 8	. . .
6	6	Tu.	♍	♅ stationary; ☌ ♅ ☾.	7 30	4 44	11 22	7 19	4 54	11 22	7 4	5 10	11 20	0 2	0 0
7	7	W.	♍	☽ 7th. ☾ in ☊.	7 29	4 45	Morn.	7 19	4 55	Morn.	7 4	5 11	Morn.	0 54	0 53
8	8	Th	♍	Mars sets 5.25 A.	7 29	4 46	0 23	7 19	4 56	0 21	7 4	5 11	0 17	1 53	1 49
9	9	Fr.	♎	☿ gr. Hel. Lat. N.	7 29	4 47	1 23	7 19	4 57	1 20	7 4	5 12	1 13	2 54	2 51
10	10	Sa.	♎	Achernar s. 6.11 A.	7 29	4 48	2 22	7 19	4 58	2 17	7 4	5 13	2 8	3 54	3 55
2. 1st Sunday after Epiphany.				Day's Length:		9h. 21m.			9h. 41m.			10h. 11m.			
11	11	Su.	♏	Hamel s. 6.34 A.	7 28	4 49	3 18	7 18	4 59	3 12	7 3	5 14	3 1	4 51	4 58
12	12	M.	♏	Jupiter rises 8.23 A.	7 28	4 50	4 11	7 18	5 0	4 4	7 3	5 15	3 51	5 40	5 54
13	13	Tu.	♏	☌ ♀ ☾; ☾ in apogee. ◡.	7 28	4 51	5 1	7 18	5 1	4 53	7 3	5 16	4 40	6 24	6 41
14	14	W.	♐	☌ ☿ ☾; ☿ stationary.	7 27	4 53	5 49	7 18	5 2	5 41	7 3	5 17	5 28	7 0	7 22
15	15	Th.	♐	Algol s. 7.18 A.	7 27	4 54	6 34	7 17	5 3	6 26	7 3	5 18	6 14	7 35	7 57
16	16	Fr.	♑	● 16th. ☌ ♂ ☾.	7 26	4 55	Sets.	7 17	5 4	Sets.	7 2	5 19	Sets.	8 4	8 29
17	17	Sa.	♑	Aldebaran s. 8.39 A.	7 26	4 56	6 33	7 16	5 5	6 39	7 2	5 19	6 49	8 31	9 0
3. 2d Sunday after Epiphany.				Day's Length:		9h. 32m.			9h. 50m.			10h. 18m.			
18	18	Su.	♑	Saturn sets 4.31 M.	7 25	4 57	7 33	7 16	5 6	7 38	7 2	5 20	7 44	8 58	9 33
19	19	M.	♒	Capella s. 9.10 A.	7 24	4 59	8 33	7 15	5 8	8 36	7 1	5 21	8 40	9 30	10 7
20	20	Tu.	♒	Rigel s. 9.7 A.	7 24	5 0	9 34	7 15	5 9	9 35	7 1	5 22	9 36	10 5	10 43
21	21	W.	♓	☾ in ☋.	7 23	5 1	10 37	7 14	5 10	10 37	7 1	5 23	10 34	10 42	11 28
22	22	Th.	♓	Canopus s. 10.11 A.	7 22	5 2	11 42	7 14	5 11	11 40	7 0	5 24	11 35	11 24	. . .
23	23	Fr.	♈	☾ 23d. Uranus rises 9.58 A.	7 22	5 4	Morn.	7 13	5 12	Morn.	7 0	5 25	Morn.	0 21	0 16
24	24	Sa.	♈	☌ ☿ ♀; ☌ ♆ ☾.	7 21	5 5	0 48	7 12	5 13	0 40	6 59	5 26	0 36	1 18	1 17
4. 3d Sunday after Epiphany.				Day's Length:		9h. 45m.			10h. 2m.			10h. 28m.			
25	25	Su.	♈	Sirius s. 10.18 A.	7 21	5 6	1 55	7 12	5 14	1 49	6 59	5 27	1 40	2 26	2 30
26	26	M.	♉	☿ gr. elong. W. 24°53′; ☌ ♄ ☾.	7 20	5 7	3 2	7 11	5 15	2 55	6 58	5 28	2 44	3 38	3 51
27	27	Tu.	♉	Neptune sets 1.41 M. ◠.	7 18	5 9	4 7	7 10	5 17	3 59	6 58	5 29	3 46	4 49	5 8
28	28	W.	♊	☾ in perigee.	7 17	5 10	5 8	7 10	5 18	5 1	6 57	5 30	4 47	5 51	6 17
29	29	Th.	♊	♆ stationary.	7 16	5 11	6 2	7 9	5 19	5 56	6 57	5 31	5 44	6 47	7 17
30	30	Fr.	♋	○ 30th. ♀ in ☋.	7 15	5 13	Rises.	7 8	5 20	Rises.	6 56	5 32	Rises.	7 39	8 11
31	31	Sa.	♋	☌ ♃ ☾.	7 14	5 14	6 47	7 7	5 21	6 53	6 55	5 33	6 57	8 27	9 2

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1810. — Charles Ellet, American engineer.
1822. — R. J. E. Clausius, German physicist.
1819. — Piazzi Smyth, Scotch astronomer.

1743. — Sir Joseph Banks, English naturalist.
1643. — Sir Isaac Newton, Eng. mathematician.
1818. — Thomas Hill, American mathematician.
1825. — J. E. Hilgard, American geodesist.
1833. — Sir Henry Roscoe, English chemist.

1808. — Wilhelm Schimper, German botanist.

1825. — William Spottiswoode, Eng. physicist.
1825. — Bayard Taylor, American traveller.
1716. — Don Antonio de Ulloa, Span. physicist.
1801. — Adolphe T. Brongniart, French botanist.
1806. — M. F. Maury, American hydrographer.
1780. — Parker Cleaveland, Amer. mineralogist.
1706. — Benjamin Franklin, Amer. philosopher.
1761. — J. Hall, Scotch geologist.
1781. — Robert Hare, American chemist.

1825. — E. Frankland, English chemist.
1736. — James Watt, Scotch mechan. engineer.
1775. — A. M. Ampère, French physicist.
1813. — John C. Fremont, Am. eng. and explorer.
1798. — Charles Davies, Amer. mathematician.
1796. — F. J. Hugi, Swiss alpinist.

1627. — Robert Boyle, Irish physicist.
1736. — J. L. Lagrange, French mathematician.
1799. — S. G. Morton, American ethnologist.

1608. — G. A. Borelli, Italian mathematician.
1688. — Emanuel Swedenborg, Swedish philos.
1700. — Daniel Bernouilli, Swiss mathematician.

MOON'S PHASES. (*Standard Time.*)

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
FULL MOON	1 0 26 M.	.. .. ..	.. .. ..	.. .. ..
LAST QUARTER	7 10 36 A.	7 9 36 A.	7 8 36 A.	7 7 36 A.
NEW MOON	16 3 36 M.	16 2 36 M.	16 1 36 M.	16 0 36 M.
FIRST QUARTER	23 8 26 A.	23 7 26 A.	23 6 26 A.	23 5 26 A.
FULL MOON	30 11 19 M.	30 10 19 M.	30 9 19 M.	30 8 19 M.

A BRIEF GUIDE TO THE DECADE.

Jan. 1, 1880, fell on Thursday.	Jan. 1, 1886, will fall on Friday.
" 1881, " " Saturday.	" 1887, " " " Saturday.
" 1882, " " Sunday.	" 1888, " " " Sunday.
" 1883, " " Monday.	" 1889, " " " Tuesday.
" 1884, " " Tuesday.	" 1890, " " " Wednesday.

"The wintry west extends his blast,
And hail and rain does blaw;
Or the stormy north sends driving forth
The blinding sleet and snaw."

BURNS.

"And once I learned how marvellous winter was,
When past the fence-rails, downy-gray with rime,
I creaked adventurous o'er the spangled crust
That made familiar fields seem far and strange."

LOWELL.

FEBRUARY, 1885.

Second Month. 28 Days.

Mean time is used unless otherwise specified.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time) Morn. H. M.	High Water, New York (Standard Time) Eve. H. M.
5. Septuagesima Sunday.				Day's Length:	10h. 2m.			10h. 16m.			10h. 39m.				
32	1	Su.	♌	☿ in ☋.	7 13	5 15	7 57	7 6	5 22	8 0	6 55	5 34	8 2	9 12	9 49
33	2	M.	♌	☌ ♅ ☾.	7 12	5 17	9 4	7 5	5 24	9 5	6 54	5 35	9 5	9 56	10 37
34	3	Tu.	♍	Venus rises 5.59 M.	7 11	5 18	10 8	7 4	5 25	10 7	6 54	5 36	10 4	10 44	11 21
35	4	W.	♍	♂ gr. Hel. Lat. S.; ☾ in ☊.	7 10	5 19	11 10	7 3	5 26	11 7	6 53	5 36	11 2	11 28	. . .
36	5	Th.	♎	Algol s. 5.56 A.	7 9	5 20	Morn.	7 2	5 27	Morn.	6 52	5 37	11 58	0 11	0 14
37	6	Fr.	♎	☽ 6th. Aldebaran s. 7.20 A.	7 8	5 22	0 10	7 1	5 28	0 6	6 51	5 38	Morn.	1 5	1 6
38	7	Sa.	♎	Capella s. 7.55 A.	7 7	5 23	1 7	7 0	5 29	1 1	6 50	5 39	0 52	2 4	2 7
6. Sexagesima Sunday.				Day's Length:	10h. 19m.			10h. 31m.			10h. 51m.				
39	8	Su.	♏	□ ♆ ☉.	7 5	5 24	2 2	6 59	5 30	1 56	6 49	5 40	1 44	3 8	3 16
40	9	M.	♏	☾ in apogee.	7 4	5 26	2 55	6 58	5 32	2 48	6 49	5 41	2 34	4 9	4 23
41	10	Tu.	♐	Mars sets 5.26 A.	7 3	5 27	3 44	6 57	5 33	3 36	6 48	5 42	3 23	5 3	5 22
42	11	W.	♐	☌ ♂ ☉; ☌ ☿ ♀.	7 1	5 28	4 29	6 56	5 34	4 22	6 47	5 43	4 9	5 49	6 9
43	12	Th.	♐	☿ in aphelion.	7 0	5 30	5 11	6 55	5 35	5 5	6 46	5 44	4 53	6 29	6 49
44	13	Fr.	♑	☌ ♀ ☾; ☌ ☿ ☾.	6 58	5 31	5 50	6 53	5 36	5 45	6 45	5 45	5 35	7 4	7 26
45	14	Sa.	♑	● 14th. ☌ ♂ ☾.	6 57	5 32	Sets.	6 52	5 38	Sets.	6 44	5 45	Sets.	7 34	7 59
7. Quinquagesima (Shrove Sunday).				Day's Length:	10h. 37m.			10h. 47m.			11h. 3m.				
46	15	Su.	♒	Jupiter rises 5.51 A.	6 56	5 33	6 25	6 51	5 38	6 29	6 43	5 46	6 33	8 4	8 34
47	16	M.	♒	♄ stationary.	6 55	5 35	7 27	6 50	5 39	7 29	6 42	5 47	7 31	8 38	9 5
48	17	Tu.	♓	☾ in ☋.	6 53	5 36	8 30	6 48	5 41	8 30	6 41	5 48	8 29	9 10	9 39
49	18	W.	♓	☍ ♃ ☉.	6 52	5 37	9 34	6 47	5 42	9 32	6 40	5 49	9 28	9 45	10 18
50	19	Th.	♓	Rigel s. 7.9 A.	6 50	5 38	10 40	6 46	5 43	10 37	6 39	5 50	10 30	10 24	11 4
51	20	Fr.	♈	☌ ♆ ☾.	6 49	5 40	11 46	6 44	5 44	11 41	6 38	5 51	11 32	11 9	11 55
52	21	Sa.	♈	☾ 22d. Saturn sets 2.15 M.	6 47	5 41	Morn.	6 43	5 45	Morn.	6 37	5 51	Morn.	. . .	0 2
8. First Sunday in Lent.				Day's Length:	10h. 56m.			11h. 4m.			11h. 16m.				
53	22	Su.	♉	☌ ♄ ☾.	6 46	5 42	0 52	6 42	5 46	0 46	6 36	5 52	0 35	0 55	1 8
54	23	M.	♉	Uranus rises 7.52 A.	6 44	5 43	1 56	6 40	5 47	1 49	6 34	5 53	1 36	2 7	2 29
55	24	Tu.	♊	Canopus s. 8.1 A.	6 43	5 45	2 56	6 39	5 48	2 48	6 33	5 54	2 35	3 24	3 54
56	25	W.	♊	☾ in perigee.	6 41	5 46	3 51	6 38	5 49	3 44	6 32	5 55	3 31	4 36	5 8
57	26	Th.	♋	Neptune sets 11.41 A.	6 40	5 47	4 41	6 36	5 50	4 35	6 31	5 56	4 24	5 38	6 12
58	27	Fr.	♋	☌ ♃ ☾.	6 38	5 48	5 25	6 35	5 51	5 21	6 30	5 56	5 12	6 33	7 4
59	28	Sa.	♌	○ 28th. ♂ in perihelion.	6 36	5 50	Rises.	6 33	5 52	Rises.	6 29	5 57	Rises.	7 22	7 53

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1813. — James D. Dana, American naturalist.
1825. — John C. Dalton, American physiologist.
1820. — Elisha K. Kane, Am. Arctic explorer.
1790. — John Bachman, American naturalist.
1770. — Alexandre Brongniart, French geologist.
1825. — Joseph Winlock, American astronomer.

1739. — William Bartram, American traveller.
1827. — William D. Whitney, Amer. philologist.
1796. — T. de la Beche, English geologist.
1847. — Thomas A. Edison, American electrician.
1809. — Charles Darwin, English naturalist.
1672. — Étienne Geoffroy, French physicist.
1728. — J. Hunter, English physiologist.
1823. — Johanne R. Wagner, German chemist.

1801. — J. T. C. Ratzeburg, German naturalist.
1740. — H. B. de Saussure, Swiss physicist.
1564. — Galileo Galilei, Italian astronomer.
1473. — N. Copernicus, German astronomer.
1745. — Alessandro Volta, Italian physicist.
1822. — Wolcott Gibbs, American chemist.

1784. — Major John E. LeConte, Am. zoölogist.
1796. — L. A. J. Quetelet, Belgian astronomer.
1804. — C. Bremiker, German mathematician.
1801. — James Deane, American geologist.
1728. — A. Baumé, French chemist.
1786. — D. F. J. Arago, French astronomer.
1823. — Joseph LeConte, American geologist.
1743. — R. J. Haüy, French mineralogist.

MOON'S PHASES. (Standard Time.)

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
Last Quarter	6 5 37 A.	6 4 37 A.	6 3 37 A.	6 2 37 A.
New Moon	14 9 22 A.	14 8 22 A.	14 7 22 A.	14 6 22 A.
First Quarter	22 5 31 M.	22 4 31 M.	22 3 31 M.	22 2 31 M.
Full Moon	28 11 0 A.	28 10 0 A.	28 9 0 A.	28 8 0 A.

A BRIEF GUIDE TO THE DECADE.

Feb. 1, 1880, fell on Sunday.	Feb. 1, 1886, will fall on Monday.
" 1881, " " Tuesday.	" 1887, " " " Tuesday.
" 1882, " " Wednesday.	" 1888, " " " Wednesday.
" 1883, " " Thursday.	" 1889, " " " Friday.
" 1884, " " Friday.	" 1890, " " " Saturday.

"HAM. — The air bites shrewdly; it is very cold.
HOR. — It is a nipping and an eager air."
SHAKSPEARE.

MARCH, 1885.

"And it is pleasant, when the noisy streams
Are just set free, and milder suns melt off
The plashy snow, save only the firm drift
In the deep glen or the close shade of pines." BRYANT.

Mean time is used unless otherwise specified.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time.) Morn. H. M.	High Water, New York Eve. H. M.
9.	2d Sunday in Lent.			Day's Length:	11h. 16m.			11h. 21m.			11h. 30m.				
60	1	Su.	♌	Canopus s. 7.41 A.	6 35	5 51	6 42	6 32	5 53	6 44	6 28	5 58	6 45	8 7	8 38
61	2	M.	♍	☌ ♅ ☾.	6 33	5 52	7 48	6 30	5 54	7 48	6 26	5 59	7 46	8 53	9 19
62	3	Tu.	♍	☾ in ☊.	6 32	5 53	8 52	6 29	5 56	8 50	6 25	5 59	8 46	9 34	10 0
63	4	W.	♍	☿ gr. Hel. Lat. S.	6 30	5 54	9 55	6 28	5 57	9 51	6 24	6 0	9 45	10 14	10 43
64	5	Th.	♎	Venus rises 5.56 M.	6 28	5 56	10 55	6 26	5 58	10 50	6 23	6 1	10 41	10 55	11 27
65	6	Fr.	♎	♀ in aphelion.	6 27	5 57	11 52	6 25	5 59	11 46	6 21	6 2	11 35	11 38	. . .
66	7	Sa.	♏	☌ ☿ ♂ : □ ♄ ☉.	6 25	5 58	Morn.	6 23	6 0	Morn.	6 20	6 3	Morn.	0 14	0 27
10.	3d Sunday in Lent.			Day's Length:	11h. 36m.			11h. 39m.			11h. 45m.				
67	8	Su.	♏	☽ 8th. Sirius s. 7.33 A.	6 23	5 59	0 46	6 22	6 1	0 39	6 19	6 4	0 26	1 9	1 25
68	9	M.	♏	☾ in apogee.	6 21	6 0	1 37	6 20	6 2	1 29	6 18	6 4	1 16	2 8	2 33
69	10	Tu.	♐	Mars rises 6.13 M.	6 20	6 1	2 24	6 19	6 3	2 16	6 16	6 5	2 3	3 11	3 43
70	11	W.	♐	Castor s. 8.8 A.	6 18	6 3	3 7	6 17	6 4	3 0	6 15	6 6	2 47	4 9	4 41
71	12	Th.	♑	Procyon s. 8.10 A.	6 16	6 4	3 46	6 15	6 5	3 40	6 14	6 6	3 29	4 59	5 29
72	13	Fr.	♑	☌ ☿ ☉ superior.	6 15	6 5	4 22	6 14	6 6	4 17	6 12	6 7	4 9	5 44	6 12
73	14	Sa.	♒	Jupiter sets 5.18 M.	6 13	6 6	4 56	6 12	6 7	4 53	6 11	6 8	4 46	6 22	6 51
11.	4th Sunday in Lent.			Day's Length:	11h. 56m.			11h. 57m.			11h. 59m.				
74	15	Su.	♒	☌ ♀ ☾ : ☌ ♂ ☾.	6 11	6 7	5 29	6 11	6 8	5 27	6 10	6 9	5 23	7 2	7 28
75	16	M.	♒	● 16th. ☌ ☿ ☾.	6 9	6 8	Sets.	6 9	6 9	Sets.	6 8	6 9	Sets.	7 38	8 2
76	17	Tu.	♓	☾ in ☋.	6 8	6 10	7 24	6 8	6 10	7 23	6 7	6 10	7 20	8 14	8 36
77	18	W.	♓	Saturn sets 0.41 M.	6 6	6 11	8 30	6 6	6 11	8 27	6 6	6 11	8 22	8 51	9 16
78	19	Th.	♈	Denebola s. 11.52 A.	6 4	6 12	9 38	6 5	6 12	9 34	6 5	6 11	9 25	9 30	9 59
79	20	Fr.	♈	☉ enters ♈, spring begins: ☌ ♆ ☾.	6 3	6 13	10 45	6 3	6 13	10 39	6 3	6 12	10 28	10 14	10 46
80	21	Sa.	♉	☍ ♅ ☉.	6 1	6 14	11 50	6 2	6 14	11 43	6 2	6 13	11 30	11 5	11 39
12.	5th Sunday in Lent.			Day's Length:	12h. 16m.			12h. 15m.			12h. 12m.				
81	22	Su.	♉	☌ ♄ ☾.	5 59	6 15	Morn.	6 0	6 15	Morn.	6 1	6 13	Morn.	. . .	0 4
82	23	M.	♊	☾ 23d. ☿ in ☊; ☾ in perigee.	5 57	6 16	0 51	5 58	6 15	0 43	5 59	6 14	0 30	0 43	1 18
83	24	Tu.	♊	Uranus sets 5.56 M.	5 56	6 17	1 47	5 57	6 16	1 40	5 58	6 15	1 27	1 54	2 43
84	25	W.	♋	Pollux s. 7.24 A.	5 54	6 18	2 37	5 55	6 17	2 31	5 57	6 16	2 20	3 11	4 2
85	26	Th.	♋	Regulus s. 9.43 A.	5 52	6 20	3 21	5 53	6 18	3 16	5 55	6 16	3 7	4 22	5 7
86	27	Fr.	♋	☌ ♃ ☾ : ☌ ♂ ♀.	5 50	6 21	4 1	5 52	6 19	3 58	5 54	6 17	3 51	5 23	6 1
87	28	Sa.	♌	☿ in perihelion; ♀ gr. Hel. Lat. S.	5 49	6 22	4 37	5 50	6 20	4 35	5 53	6 18	4 31	6 15	6 47
13.	Palm Sunday.			Day's Length:	12h. 36m.			12h. 32m.			12h. 27m.				
88	29	Su.	♌	☌ ♅ ☾.	5 47	6 23	5 12	5 49	6 21	5 12	5 51	6 18	5 11	7 6	7 30
89	30	M.	♍	○ 30th. ☾ in ☊.	5 45	6 24	Rises.	5 47	6 22	Rises.	5 50	6 19	Rises.	7 48	8 12
90	31	Tu.	♍	Neptune sets 9.36 A.	5 43	6 25	7 39	5 46	6 23	7 36	5 49	6 20	7 31	8 29	8 51

Third Month. 31 Days.

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1811. — Hugh E. Strickland, Eng. naturalist.
1847. — Alexander Graham Bell, Am. electrician.
1792. — Isaac Lea, American naturalist.
1512. — G. Mercator, French geographer.
1787. — J. Fraunhofer, German physicist.
1746. — André Michaux, American botanist.
1792. — Sir William Herschel, Eng. astronomer.
1837. — Henry Draper, American astronomer.

1451. — Amerigo Vespucci, Italian explorer.
1628. — M. Malpighi, Italian naturalist.
1811. — U. J. J. LeVerrier, French astronomer.
1835. — Simon Newcomb, Amer. mathematician.
1733. — J. Priestley, English chemist.
1819. — E. Edlund, Swedish physicist.

1776. — Gerald Troost, American geologist.
1801. — George P. Marsh, American philologist.
1750. — Caroline L. Herschel, Eng. astronomer.
1787. — G. S. Ohm, German physicist.
1800. — F. Lieber, Am. publicist and geologist.
1782. — W. Biela, Austrian astronomer.
1834. — C. W. Eliot, Am. chemist and educator.
1768. — J. B. J. Fourier, French physicist.

1799. — F. W. Argelander, German astronomer.
1769. — William Smith, English geologist.
1834. — J. W. Powell, Am. geol. and ethnologist.
1516. — C. Gesner, German naturalist.
1753. — Count Rumford, American physicist.
1773. — Nathaniel Bowditch, Am. mathematic'n.
1749. — P. S. LaPlace, French mathematician.
1793. — Henry R. Schoolcraft, Am. ethnologist.

1596. — Réné D. Descartes, French philosopher.

MOON'S PHASES.
(Standard Time.)

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	8 1 54 A.	8 0 54 A.	8 11 54 M.	8 10 54 M.
NEW MOON	16 0 37 A.	16 11 37 M.	16 10 37 M.	16 9 37 M.
FIRST QUARTER	23 0 23 A.	23 11 23 M.	23 10 23 M.	23 9 23 M.
FULL MOON	30 11 40 M.	30 10 40 M.	30 9 40 M.	30 8 40 M.

A BRIEF GUIDE TO THE DECADE.

Mar. 1, 1880, fell on Monday.	Mar. 1, 1886, will fall on Monday.
" 1881, " " Tuesday.	" 1887, " " " Tuesday.
" 1882, " " Wednesday.	" 1888, " " " Thursday.
" 1883, " " Thursday.	" 1889, " " " Friday.
" 1884, " " Saturday.	" 1890, " " " Saturday.

“And every plaine was yclothed faire
With newe greene, and maketh smale floures
To springen here and there in fielde and mede:
So very good and wholesome be the shoures.”
CHAUCER.

APRIL, 1885.

“Lodged in sunny cleft,
Where the cold breezes come not, blooms alone
The little wind-flower, whose just opened eye
Is blue as the spring heaven it gazes at,
Startling the loiterer in the naked groves
With unexpected beauty.”
BRYANT.

Fourth Month. 30 Days.

Mean time is used unless otherwise specified.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston: Sun Rises. H. M.	Boston: Sun Sets. H. M.	Boston: Moon Rises. H. M.	Washington: Sun Rises. H. M.	Washington: Sun Sets. H. M.	Washington: Moon Rises. H. M.	Charleston, S.C.: Sun Rises. H. M.	Charleston, S.C.: Sun Sets. H. M.	Charleston, S.C.: Moon Rises. H. M.	High Water, New York (Standard Time): Morn. H. M.	High Water, New York (Standard Time): Eve. H. M.	BIRTHDAYS OF SCIENTIFIC CELEBRITIES.
91	1	W.	♎	Regulus s. 9.20 A.	5 42	6 26	8 40	5 44	6 24	8 36	5 47	6 20	8 28	9 8	9 29	1744. — J. B. Lamarck, French zoölogist.
92	2	Th.	♎	Venus rises 5.33 M.	5 40	6 28	9 39	5 43	6 25	9 33	5 46	6 21	9 23	9 47	10 7	1764. — E. F. Schlotheim, Ger. paleontologist.
93	3	Fr.	♏	Pollux s. 6.48 A.	5 38	6 29	10 35	5 41	6 26	10 28	5 45	6 22	10 16	10 26	10 45	1793. — Dionysius Lardner, Irish physicist.
94	4	Sa.	♏	Denebola s. 10.49 A.	5 36	6 30	11 28	5 39	6 27	11 20	5 44	6 23	11 7	11 7	11 26	1809. — Benjamin Peirce, Amer. mathematician. 1823. — Sir William Siemens, Eng. physicist.
14.	Easter Sunday.			Day's Length:	12h. 56m.			12h. 50m.			12h. 41m.					
95	5	Su.	♏	Spica s. 0.24 M. ☋.	5 35	6 31	Morn.	5 38	6 28	Morn.	5 42	6 23	11 56	11 53	...	1768. — Diedrich Karsten, Ger. mineralogist.
96	6	M.	♐	☾ in apogee.	5 33	6 32	0 17	5 36	6 29	0 9	5 41	6 24	Morn.	0 12	0 47	
97	7	Tu.	♐	☽ 7th. ☿ gr. Hel. Lat. N.	5 31	6 33	1 1	5 35	6 30	0 54	5 40	6 25	0 41	1 3	1 49	1727. — M. Adanson, French naturalist.
98	8	W.	♑	☿ gr. elong. E. 19°26′.	5 30	6 34	1 41	5 33	6 31	1 35	5 38	6 25	1 23	1 58	2 53	1732. — David Rittenhouse, Amer. astronomer.
99	9	Th.	♑	Mars rises 5.10 M.	5 28	6 35	2 19	5 32	6 32	2 14	5 37	6 26	2 4	2 59	3 53	1814. — C. J. Malmsten, Swedish mathematician.
100	10	Fr.	♑	Arcturus s. 0.56 M.	5 26	6 36	2 54	5 30	6 33	2 50	5 36	6 27	2 43	3 55	4 40	
101	11	Sa.	♒	Alphacca s. 2.11 M.	5 25	6 38	3 27	5 29	6 34	3 25	5 35	6 28	3 20	4 53	5 24	1804. — O. L. Erdmann, German chemist.
15.	Low Sunday.			Day's Length:	13h. 16m.			13h. 8m.			12h. 55m.					
102	12	Su.	♒	Jupiter sets 3.19 M.	5 23	6 39	3 59	5 27	6 35	3 58	5 33	6 28	3 56	5 48	6 7	1773. — Thomas Thomson, English chemist.
103	13	M.	♓	☌ ♂ ☾ : ☾ in ☋.	5 21	6 40	4 31	5 26	6 36	4 32	5 32	6 29	4 32	6 22	6 49	1743. — Thos. Jefferson, Am. statesman and nat.
104	14	Tu.	♓	● 14th. ☌ ♀ ☾.	5 20	6 41	5 5	5 24	6 37	5 8	5 31	6 30	5 11	7 5	7 31	1629. — C. Huyghens, Dutch physicist.
105	15	W.	♈	15th. ☌ ☿ ☾.	5 18	6 42	Sets.	5 23	6 38	Sets.	5 30	6 30	Sets.	7 48	8 14	1772. — E. G. Saint-Hilaire, French zoölogist. 1800. — James C. Ross, Brit. Arctic navigator.
106	16	Th.	♈	☌ ♆ ☾.	5 17	6 43	8 31	5 21	6 38	8 26	5 29	6 31	8 16	8 33	8 58	
107	17	Fr.	♉	☿ stationary.	5 15	6 44	9 40	5 20	6 39	9 33	5 27	6 32	9 21	9 20	9 44	1794. — K. F. P. Martius, German botanist.
108	18	Sa.	♉	☌ ♄ ☾ : ☾ in perigee.	5 14	6 45	10 45	5 19	6 40	10 37	5 26	6 32	10 24	10 12	10 34	1822. — A. Petermann, German geographer.
16.	2d Sunday after Easter.			Day's Length:	13h. 34m.			13h. 24m.			13h. 8m.					
109	19	Su.	♊	Saturn sets 10.43 A. ☊.	5 12	6 46	11 43	5 17	6 41	11 35	5 25	6 33	11 22	11 9	11 30	1795. — C. G. Ehrenberg, German naturalist.
110	20	M.	♊	Antares s. 2.28 M.	5 10	6 48	Morn.	5 16	6 42	Morn.	5 24	6 34	Morn.	...	0 15	1824. — Jules Marcou, Swiss and Am. geologist.
111	21	Tu.	♊	☾ 21st. ♃ stationary.	5 9	6 49	0 35	5 14	6 43	0 28	5 23	6 35	0 16	0 32	1 29	1807. — L. Palmieri, Italian physicist.
112	22	W.	♋	Vega s. 4.31 M.	5 7	6 50	1 22	5 13	6 44	1 17	5 22	6 35	1 6	1 41	2 46	1724. — Immanuel Kant, German philosopher.
113	23	Th.	♋	☌ ♃ ☾.	5 6	6 51	2 2	5 12	6 45	1 58	5 21	6 36	1 50	2 52	3 55	1798. — Sir W. E. Logan, Canadian geologist.
114	24	Fr	♌	Uranus sets 3.52 M.	5 4	6 52	2 38	5 10	6 46	2 36	5 20	6 37	2 31	3 59	4 52	
115	25	Sa.	♌	☌ ♅ ☾.	5 3	6 53	3 12	5 9	6 47	3 12	5 19	6 37	3 9	5 4	5 43	1819. — Otto W. Struve, Russian astronomer.
17.	3d Sunday after Easter.			Day's Length:	13h. 53m.			13h. 40m.			13h. 21m.					
116	26	Su.	♍	☾ in ☊.	5 1	6 54	3 45	5 8	6 48	3 46	5 17	6 38	3 47	5 56	6 29	1774. — C. L. von Buch, German geologist.
117	27	M.	♍	☌ ☿ ☉ inferior.	5 0	6 55	4 17	5 7	6 49	4 20	5 16	6 39	4 23	6 44	7 10	1791. — S. F. B. Morse, American electrician.
118	28	Tu.	♎	○ 28th. ☌ ☿ ♀.	4 59	6 56	4 48	5 5	6 50	4 53	5 15	6 40	4 59	7 26	7 48	1782. — William Darlington, American botanist.
119	29	W.	♎	29th. Neptune sets 7.46 A.	4 57	6 58	Rises.	5 4	6 51	Rises.	5 14	6 41	Rises.	8 8	8 28	1811. — J. W. Bailey, American microscopist.
120	30	Th.	♎	☿ in ☋.	4 56	6 59	8 24	5 3	6 52	8 18	5 13	6 41	8 6	8 47	9 3	1834. — Sir J. Lubbock, English naturalist.

MOON'S PHASES.
(Standard Time.)

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	7 9 42 M.	7 8 42 M.	7 7 42 M.	7 6 42 M.
NEW MOON	15 0 52 M.	14 11 52 A.	14 10 52 A.	14 9 52 A.
FIRST QUARTER	21 6 20 A.	21 5 20 A.	21 4 20 A.	21 3 20 A.
FULL MOON	29 1 14 M.	29 0 14 M.	28 11 14 A.	28 10 14 A.

A BRIEF GUIDE TO THE DECADE.

April 1, 1880, fell on Thursday.	April 1, 1886, will fall on Thursday.
“ 1881, “ “ Friday.	“ 1887, “ “ “ Friday.
“ 1882, “ “ Saturday.	“ 1888, “ “ “ Sunday.
“ 1883, “ “ Sunday.	“ 1889, “ “ “ Monday.
“ 1884, “ “ Tuesday.	“ 1890, “ “ “ Tuesday.

"A violet by a mossy stone
Half hidden from the eye!
Fair as a star, when only one
Is shining in the sky."
WORDSWORTH.

MAY, 1885.

"For half our May's so awfully like mayn't,
'Twould rile a Shaker or an evrige saint;
Though I own up I like our back'ard springs
Thet kind o' haggle with their greens an' things,
An' when you most give up 'ithout more words
Toss the fields full o' blossoms, leaves, an' birds." LOWELL.

Mean time is used unless otherwise specified.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time.) Morn. H. M.	High Water, New York Eve. H. M.
121	1	Fr.	♏	Regulus s. 7.22 A.	4 54	7 0	9 19	5 2	6 53	9 12	5 12	6 42	8 59	9 23	9 37
122	2	Sa.	♏	Venus rises 5.6 M.	4 53	7 1	10 10	5 0	6 54	10 2	5 11	6 43	9 49	10 1	10 10
18.	4th Sunday after Easter.			Day's Length:	14h. 10m.			13h. 56m.			13h. 33m.				
123	3	Su.	♐	Denebola s. 8.55 A. ◡.	4 52	7 2	10 57	4 59	6 55	10 49	5 10	6 43	10 36	10 39	10 44
124	4	M.	♐	☌ ♀ ☉ superior; ☾ in apogee.	4 50	7 3	11 40	4 58	6 56	11 33	5 9	6 44	11 21	11 22	11 23
125	5	Tu.	♐	Spica s. 10.23 A.	4 49	7 4	Morn.	4 57	6 57	Morn.	5 9	6 45	Morn.	. . .	0 8
126	6	W.	♑	Mars rises 4.15 M.	4 48	7 5	0 18	4 56	6 57	0 12	5 8	6 45	0 2	0 5	1 3
127	7	Th.	♑	☽ 7th. Arcturus s. 11.6 A	4 47	7 6	0 53	4 55	6 58	0 49	5 7	6 46	0 40	0 56	1 57
128	8	Fr.	♒	Alphacca s. 0.25 M.	4 46	7 8	1 26	4 54	6 59	1 23	5 6	6 47	1 17	1 55	2 51
129	9	Sa.	♒	Jupiter sets 1.33 M.	4 44	7 9	1 57	4 53	7 0	1 56	5 5	6 47	1 52	2 54	3 47
19.	Rogation Sunday.			Day's Length:	14h. 27m.			14h. 9m.			13h. 44m.				
130	10	Su.	♒	☿ in aphelion; ☾ in ☋.	4 43	7 10	2 28	4 52	7 1	2 28	5 4	6 48	2 27	3 51	4 40
131	11	M.	♓	☿ stationary; ☌ ♆ ♀.	4 42	7 11	3 1	4 51	7 2	3 3	5 3	6 49	3 5	4 47	5 26
132	12	Tu.	♓	☌ ♂ ☾; ☌ ☿ ☾.	4 41	7 12	3 35	4 50	7 3	3 39	5 3	6 50	3 43	5 41	6 19
133	13	W.	♈	☌ ☿ ♂; ☌ ♆ ☉.	4 40	7 13	4 12	4 49	7 4	4 18	5 2	6 51	4 26	6 35	7 8
134	14	Th.	♈	● 14th. ☌ ♆ ☾; ☌ ♀ ☾.	4 39	7 14	Sets.	4 48	7 5	Sets.	5 1	6 51	Sets.	7 28	7 56
135	15	Fr.	♉	Saturn sets 9.13 A.	4 38	7 15	8 30	4 47	7 6	8 23	5 1	6 52	8 10	8 19	8 44
136	16	Sa.	♉	☌ ♄ ☾; ☾ in perigee. ⌒.	4 37	7 16	9 33	4 46	7 7	9 25	5 0	6 53	9 12	9 14	9 34
20.	Sunday after Ascension.			Day's Length:	14h. 41m.			14h. 23m.			13h. 54m.				
137	17	Su.	♊	□ ♃ ☉.	4 36	7 17	10 30	4 45	7 8	10 23	4 59	6 53	10 10	10 10	10 24
138	18	M.	♊	Antares s. 0.38 M.	4 35	7 18	11 20	4 44	7 8	11 14	4 59	6 54	11 3	11 10	11 19
139	19	Tu.	♋	Vega s. 2 44 M.	4 34	7 19	Morn.	4 44	7 9	11 59	4 58	6 55	11 50	. . .	0 15
140	20	W.	♋	☾ 20th. ☌ ♃ ☾.	4 33	7 20	0 3	4 43	7 10	Morn.	4 57	6 56	Morn.	0 17	1 24
141	21	Th.	♌	21st. Uranus sets 2.5 M.	4 32	7 21	0 41	4 42	7 11	0 38	4 57	6 56	0 32	1 19	2 30
142	22	Fr.	♌	☌ ♅ ☾.	4 32	7 22	1 16	4 41	7 12	1 15	4 56	6 57	1 12	2 29	3 33
143	23	Sa.	♍	♀ in ☊.	4 31	7 23	1 49	4 41	7 13	1 50	4 56	6 58	1 49	3 36	4 30
21.	Pentecost (Whit Sunday).			Day's Length:	14h. 54m.			14h. 33m.			14h. 3m.				
144	24	Su.	♍	☾ in ☊.	4 30	7 24	2 20	4 40	7 13	2 23	4 55	6 58	2 25	4 37	5 24
145	25	M.	♍	☿ gr. elong. W. 24°59′.	4 29	7 25	2 51	4 39	7 14	2 55	4 55	6 59	3 0	5 31	6 11
146	26	Tu.	♎	Altair s. 3.29 M.	4 28	7 26	3 23	4 39	7 15	3 29	4 55	6 59	3 37	6 22	6 54
147	27	W.	♎	Spica s. 8 56 A.	4 28	7 26	3 59	4 38	7 16	4 6	4 54	7 0	4 17	7 8	7 34
148	28	Th.	♏	○ 28th. Neptune rises 4.5 M.	4 27	7 27	Rises.	4 38	7 17	Rises.	4 54	7 1	Rises.	7 51	8 9
149	29	Fr.	♏	☌ ♃ *Regulus.*	4 27	7 28	8 5	4 37	7 17	7 58	4 53	7 1	7 44	8 30	8 43
150	30	Sa.	♐	☌ ♀ ♂. ◡.	4 26	7 29	8 53	4 37	7 18	8 45	4 53	7 2	8 32	9 7	9 12
22.	Trinity Sunday.			Day's Length:	15h. 4m.			14h. 43m.			14h. 9m.				
151	31	Su.	♐	☿ gr. Hel. Lat. S.; ☾ in apogee.	4 26	7 30	9 38	4 36	7 19	9 31	4 53	7 2	9 18	9 42	9 40

Fifth Month. *31 Days.*

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1797. — H. K. W. Berghaus, Ger. geographer.
1809. — L. G. de Koninck, Belg. paleontologist.
1825. — Thomas H. Huxley, English naturalist.
1811. — J. W. Draper, American physicist.
1832. — Isaac I. Hayes, American explorer.
1833. — F. P. W. Richthofen, German geologist.

1785. — James P. Espy. Amer. meteorologist.

1773. — William Phillips, English geologist.
1788. — A. J. Fresnel, French physicist.
1722. — Peter Camper, Dutch physiologist.
1803. — J. J. Liebig, German chemist.
1825. — Joseph Leidy, American biologist.
1686. — G. D. Fahrenheit, German physicist.
1780. — J. J. Audubon, American ornithologist.
1799. — Ebenezer Emmons, American geologist.

1741. — Faujas de Saint-Fond, French geologist.
1778. — Andrew Ure, Scotch chemist.
1815. — Gen. J. G. Barnard, American engineer.

1819. — Sir Lyon Playfair, English chemist.

1790. — J. Dumont d'Urville, French navigator.

1707. — Carl von Linné, Swedish naturalist.
1793. — Edward Hitchcock, Amer. geologist.
1794. — William Whewell, English physicist.
1803. — Prince C. L. Bonaparte, Fr. ornithol.
1820. — W. Chauvenet, Amer. mathematician.
1807. — Louis Agassiz, Swiss and Am. naturalist.
1716. — L. Daubenton, French mineralogist.
1797. — K. F. Naumann, Ger. mineralogist.
1817. — H. A. Hagen, Ger. and Am. entomol.

MOON'S PHASES. (*Standard Time.*)	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	7 3 43 M.	7 2 43 M.	7 1 43 M.	7 0 43 M.
NEW MOON	14 10 17 M.	14 9 17 M.	14 8 17 M.	14 7 17 M.
FIRST QUARTER	21 0 45 M.	20 11 45 A.	20 10 45 A.	20 9 45 A.
FULL MOON	28 3 31 A.	28 2 31 A.	28 1 31 A.	28 0 31 A.

A BRIEF GUIDE TO THE DECADE.

May 1, 1880, fell on Saturday.	May 1, 1886, will fall on Saturday.
" 1881, " " Sunday.	" 1887, " " " Sunday.
" 1882, " " Monday.	" 1888, " " " Tuesday.
" 1883, " " Tuesday.	" 1889, " " " Wednesday.
" 1884, " " Thursday.	" 1890, " " " Thursday.

"'Tis heaven alone is given away,
'Tis only God may be had for the asking,
No price is set on the lavish summer,
June may be had by the poorest comer."
LOWELL.

JUNE, 1885.

"The oriole should build and tell
His love-tale close beside my cell;
The idle butterfly
Should rest him there, and there be heard
The housewife bee and humming-bird." BRYANT.

Mean time is used unless otherwise specified.

Sixth Month. 30 Days.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time.) Morn. H. M.	High Water, New York (Standard Time.) Eve. H. M.	BIRTHDAYS OF SCIENTIFIC CELEBRITIES.
152	1	M.	♐	Spica s. 8.36 A.	4 25	7 30	10 18	4 36	7 19	10 12	4 52	7 3	10 1	10 16	10 9	
153	2	Tu.	♑	Venus sets 7.54 A.	4 25	7 31	10 53	4 36	7 20	10 48	4 52	7 3	10 39	10 52	10 43	
154	3	W.	♑	Arcturus s. 9.20 A.	4 24	7 32	11 26	4 35	7 21	11 22	4 52	7 4	11 15	11 33	11 24	1726. — J. Hutton, Scotch geologist.
155	4	Th	♒	Alphacca s. 10.35 A.	4 24	7 32	11 58	4 35	7 21	11 56	4 52	7 5	11 51	. . .	0 14	1787. — L. C. Prévost, French geologist.
156	5	Fr.	♒	☽ 5th. ♅ stationary; ☌ ♆ ☿.	4 24	7 33	Morn.	4 35	7 22	Morn.	4 52	7 5	Morn.	0 8	1 4	1819. — J. C. Adams, English astronomer.
157	6	Sa.	♒	☾ in ☋.	4 23	7 34	0 29	4 34	7 23	0 28	4 51	7 5	0 26	0 58	2 2	1436. — Regiomontanus, German astronomer.
23.	1st Sunday after Trinity.			Day's Length:	15h. 11m.			14h. 49m.			14h. 15m.					
158	7	Su.	♓	☌ ♄ ♀.	4 23	7 34	1 0	4 34	7 23	1 1	4 51	7 6	1 1	1 55	3 1	
159	8	M.	♓	Mars rises 3.11 M.	4 23	7 35	1 31	4 34	7 24	1 34	4 51	7 6	1 37	2 57	4 0	1821. — Sir Samuel W. Baker, Eng. traveller.
160	9	Tu.	♈	Antares s. 11.8 A.	4 23	7 36	2 5	4 34	7 24	2 10	4 51	7 7	2 16	4 2	4 59	
161	10	W.	♈	☌ ♆ ♂; ☌ ♆ ☾; ☌ ♂ ☾.	4 22	7 36	2 44	4 34	7 25	2 50	4 51	7 7	3 0	5 7	5 54	1706. — J. Dollond, English optician.
162	11	Th.	♉	☌ ☿ ☾.	4 22	7 37	3 29	4 34	7 25	3 37	4 51	7 8	3 49	6 10	6 48	1790. — J. E. Teschemacher, Am. mineralogist.
163	12	Fr.	♉	● 12th. ☌ ♄ ☾.	4 22	7 37	Sets.	4 34	7 26	Sets.	4 51	7 8	Sets.	7 10	7 40	
164	13	Sa.	♊	☌ ♀ ☾: ☾ in perigee. ☊.	4 22	7 38	8 17	4 34	7 26	8 10	4 51	7 8	7 56	8 9	8 32	1773. — Thomas Young, English physicist.
24.	2d Sunday after Trinity.			Day's Length:	15h. 16m.			14h. 53m.			14h. 18m.					
165	14	Su.	♊	Jupiter sets 11.17 A.	4 22	7 38	9 11	4 34	7 27	9 5	4 51	7 9	8 53	9 7	9 22	
166	15	M.	♋	Vega s. 0.58 M.	4 22	7 38	10 0	4 34	7 27	9 55	4 51	7 9	9 45	10 3	10 12	
167	16	Tu.	♋	Altair s. 2.6 M.	4 22	7 39	10 42	4 34	7 27	10 38	4 51	7 10	10 31	11 0	11 4	1800. — Lord Rosse, Irish astronomer.
168	17	W.	♌	☌ ♃ ☾.	4 22	7 39	11 19	4 34	7 27	11 17	4 51	7 10	11 13	11 59	11 57	1821. — E. G. Squier, American archeologist.
169	18	Th.	♌	☌ ♄ ☉.	4 23	7 39	11 52	4 34	7 28	11 52	4 52	7 10	11 51	. . .	1 0	1791. — Denison Olmstead, American physicist.
170	19	Fr.	♍	☾ 19th. ☌ ♅ ☾; ☿ in ☊; □ ♅ ☉.	4 23	7 40	Morn.	4 34	7 28	Morn.	4 52	7 11	Morn.	0 56	1 59	1781. — George Stephenson, English engineer.
171	20	Sa.	♍	☾ in ☊.	4 23	7 40	0 23	4 34	7 28	0 25	4 52	7 11	0 26	1 58	3 2	1811. — Carlo Matteucci, Italian physicist.
25.	3d Sunday after Trinity.			Day's Length:	15h. 17m.			14h. 55m.			14h. 19m.					
172	21	Su.	♍	☉ enters ♋; summer begins.	4 23	7 40	0 54	4 34	7 29	0 58	4 52	7 11	1 2	3 1	4 3	1646. — G. W. Leibnitz, German mathematician.
173	22	M.	♎	Saturn rises 4.31 M.	4 23	7 40	1 26	4 35	7 29	1 31	4 52	7 11	1 39	4 4	5 0	1781. — S. D. Poisson, French physicist.
174	23	Tu.	♎	☌ ☿ ♄.	4 24	7 40	2 1	4 35	7 29	2 8	4 53	7 11	2 17	5 6	5 51	1815. — J. J. Oppel, German physicist.
175	24	W.	♏	☿ in perihelion.	4 24	7 40	2 38	4 35	7 29	2 46	4 53	7 11	2 58	6 2	6 35	1777. — John Ross, British Arctic navigator.
176	25	Th.	♏	Uranus sets 11.43 A.	4 24	7 40	3 18	4 36	7 29	3 27	4 53	7 11	3 40	6 52	7 17	1814. — Paul Daubrée, French geologist.
177	26	Fr.	♏	♀ in perihelion. ☋.	4 25	7 40	4 1	4 36	7 29	4 10	4 54	7 12	4 24	7 36	7 53	
178	27	Sa.	♐	○ 27th. ☌ ☿ ☉ superior.	4 25	7 40	Rises.	4 37	7 29	Rises.	4 54	7 12	Rises.	8 14	8 23	1806. — A. de Morgan, English mathematician.
26.	4th Sunday after Trinity.			Day's Length:	15h. 15m.			14h. 52m.			14h. 18m.					
179	28	Su.	♐	☾ in apogee.	4 25	7 40	8 18	4 37	7 29	8 11	4 54	7 12	8 0	8 48	8 50	1812. — C. G. Page, American electrician.
180	29	M.	♑	Fomalhaut s. 4.21 M.	4 26	7 40	8 55	4 37	7 29	8 49	4 55	7 12	8 39	9 19	9 14	1804. — C. U. Shepard, American mineralogist.
181	30	Tu.	♑	Neptune rises 1.59 M.	4 26	7 40	9 29	4 38	7 29	9 25	4 55	7 12	9 17	9 49	9 41	1818. — Angelo Secchi, Italian astronomer.

MOON'S PHASES. (*Standard Time.*)	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	5 7 5 A.	5 6 5 A.	5 5 5 A.	5 4 5 A.
NEW MOON	12 5 42 A.	12 4 42 A.	12 3 42 A.	12 2 42 A.
FIRST QUARTER	19 8 48 M.	19 7 48 M.	19 6 48 M.	19 5 48 M.
FULL MOON	27 6 18 M.	27 5 18 M.	27 4 18 M.	27 3 18 M.

A BRIEF GUIDE TO THE DECADE.

June 1, 1880, fell on Tuesday.	June 1, 1886, will fall on Tuesday.
" 1881, " " Wednesday.	" 1887, " " " Wednesday.
" 1882, " " Thursday.	" 1888, " " " Friday.
" 1883, " " Friday.	" 1889, " " " Saturday.
" 1884, " " Sunday.	" 1890, " " " Sunday.

"There, through the long, long summer hours,
The golden light should lie,
And thick young herbs and groups of flowers
Stand in their beauty by."
BRYANT.

JULY, 1885.

"*The crows flapped over by twos and threes,*
In the pool drowsed the cattle up to their knees,
The little birds sang as if it were
The one day of summer in all the year,
And the very leaves seemed to sing on the trees." LOWELL.

Mean time is used unless otherwise specified.

Seventh Month. 31 Days.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Latitude of Boston. Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Latitude of Washington. Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Latitude of Charleston, S.C. Sun Rises. H. M.	Charleston Sun Sets. H. M.	Charleston Moon Rises. H. M.	High Water, New York (Standard Time.) Morn. H. M.	High Water Eve. H. M.	BIRTHDAYS OF SCIENTIFIC CELEBRITIES.
182	1	W.	♑	♂ in ☊.	4 27	7 40	10 1	4 38	7 29	9 58	4 55	7 12	9 52	10 22	10 14	1750. — Franz Huber, Swiss entomologist.
183	2	Th.	♒	Venus sets 8.30 A.	4 27	7 40	10 31	4 39	7 29	10 30	4 56	7 12	10 26	10 56	10 49	1803. — Edouard Constant Biot, Fr. astronomer.
184	3	Fr.	♒	☉ in apogee; ☾ in ☋.	4 28	7 40	11 1	4 39	7 29	11 1	4 56	7 12	11 0	11 35	11 28	1840. — Francis A. Walker, American publicist.
185	4	Sa.	♓	☿ gr. Hel. Lat. N.	4 29	7 39	11 32	4 40	7 28	11 34	4 57	7 11	11 36	. . .	0 23	
27.	5th Sunday after Trinity.			Day's Length:	15h. 10m.			14h. 48m.			14h. 14m.					1817. — Karl Vogt, Swiss naturalist.
186	5	Su.	♓	☽ 5th. Alphacca s. 8.33 A.	4 29	7 39	Morn.	4 40	7 28	Morn.	4 57	7 11	Morn.	0 15	1 18	1820. — W. J. M. Rankine, Scotch engineer.
187	6	M.	♓	Antares s. 9.21 A.	4 29	7 39	0 4	4 41	7 28	0 8	4 58	7 11	0 12	1 10	2 19	1766. — Alexander Wilson, Amer. ornithologist.
188	7	Tu.	♈	Mars rises 2.27 M.	4 30	7 38	0 39	4 41	7 28	0 45	4 58	7 11	0 53	2 15	3 25	1831. — Daniel C. Gilman, American educator.
189	8	W.	♈	☌ ♆ ☾.	4 31	7 38	1 19	4 42	7 27	1 26	4 59	7 11	1 37	3 28	4 33	1809. — Robert W. Gibbes, American naturalist.
190	9	Th.	♉	☌ ♂ ☾.	4 32	7 38	2 5	4 43	7 27	2 13	4 59	7 10	2 26	4 43	5 34	1809. — F. A. Quenstedt, German geologist.
191	10	Fr.	♉	☌ ♄ ☾. ☊.	4 33	7 37	2 59	4 43	7 26	3 8	4 59	7 10	3 22	5 54	6 32	1732. — J. J. de LaLande, French astronomer.
192	11	Sa.	♊	☾ in perigee.	4 33	7 37	4 2	4 44	7 26	4 11	5 0	7 10	4 25	6 58	7 27	1795. — Samuel L. Dana, American chemist.
28.	6th Sunday after Trinity.			Day's Length:	15h. 2m.			14h. 41m.			14h. 8m.					1811. — W. R. Grove, English physicist.
193	12	Su.	♊	● 11th, 12th. Jupiter sets 9.37 A.	4 34	7 36	Sets.	4 45	7 26	Sets.	5 1	7 9	Sets.	7 57	8 18	1817. — Henry D. Thoreau, Amer. naturalist.
194	13	M.	♋	☌ ☿ ☾; ☌ ♀ ☾.	4 35	7 36	8 35	4 45	7 25	8 31	5 1	7 9	8 22	8 54	9 7	1800. — J. B. Dumas, French chemist.
195	14	Tu.	♋	☌ ♃ ☾.	4 36	7 35	9 16	4 46	7 24	9 13	5 2	7 9	9 8	9 47	9 55	1801. — Johannes Müller, German physiologist.
196	15	W.	♌	Vega s. 10.56 A.	4 37	7 34	9 52	4 47	7 24	9 51	5 3	7 8	9 49	10 39	10 42	
197	16	Th.	♌	☌ ♅ ☾.	4 38	7 34	10 25	4 48	7 23	10 26	5 3	7 8	10 26	11 32	11 34	1746. — G. Piazzi, Italian astronomer.
198	17	Fr.	♍	☌ ☿ ♀; ☾ in ☊.	4 38	7 33	10 57	4 48	7 23	11 0	5 4	7 8	11 3	. . .	0 23	1768. — Thaddeus M. Harris, Amer. naturalist.
199	18	Sa.	♍	♀ gr. Hel. Lat. N.	4 39	7 32	11 30	4 49	7 22	11 35	5 5	7 7	11 40	0 26	1 22	1811. — Karl L. Littrow, Austrian astronomer.
29.	7th Sunday after Trinity.			Day's Length:	14h. 52m.			14h. 32m.			14h. 2m.					
200	19	Su.	♎	☾ 18th. Saturn rises 3.0 M.	4 40	7 32	Morn.	4 50	7 22	Morn.	5 5	7 7	Morn.	1 23	2 24	1806. — A. D. Bache, American geodesist.
201	20	M.	♎	☌ ♄ η Geminorum.	4 41	7 31	0 4	4 51	7 21	0 10	5 6	7 6	0 18	2 24	3 29	1846. — Edward C. Pickering, Am. astronomer.
202	21	Tu.	♏	Altair s. 11.45 A.	4 42	7 30	0 40	4 52	7 20	0 48	5 7	7 5	0 58	3 33	4 30	1810. — H. V. Regnault, French physicist.
203	22	W.	♏	Fomalhaut s. 2.50 M.	4 43	7 29	1 19	4 52	7 19	1 27	5 7	7 5	1 40	4 42	5 24	1784. — F. W. Bessel, German astronomer.
204	23	Th.	♏	Markab. s. 2.54 M. ☋.	4 44	7 28	2 1	4 53	7 19	2 10	5 8	7 4	2 24	5 41	6 13	1752. — M. A. Pictet, Swiss physicist.
205	24	Fr.	♐	Uranus sets 9.51 A.	4 45	7 27	2 46	4 54	7 18	2 55	5 8	7 4	3 9	6 33	6 48	1737. — A. Dalrymple, English hydrographer.
206	25	Sa.	♐	☾ in apogee.	4 46	7 26	3 34	4 55	7 17	3 43	5 9	7 3	3 57	7 16	7 29	1778. — Heinrich A. Vogel, German chemist.
30.	8th Sunday after Trinity.			Day's Length:	14h. 38m.			14h. 20m.			13h. 52m.					
207	26	Su.	♐	○ 26th. ☌ ☿ *Regulus.*	4 47	7 25	4 27	4 56	7 16	4 35	5 10	7 2	4 48	7 51	7 59	1787. — T. F. L. Nees v. Esenbeck, Ger. botanist.
208	27	M.	♑	☿ in ☋.	4 48	7 24	Rises.	4 57	7 15	Rises.	5 10	7 2	Rises.	8 24	8 26	1667. — Johann Bernouilli, Swiss mathematician.
209	28	Tu.	♑	Algenib s. 3.43 M.	4 49	7 23	8 5	4 57	7 14	8 2	5 11	7 1	7 55	8 53	8 49	1787. — Thomas Say, American zoölogist.
210	29	W.	♒	Polaris s. 4.48 M.	4 50	7 22	8 35	4 58	7 13	8 33	5 12	7 0	8 29	9 21	9 18	1801. — G. B. Airy, English astronomer.
211	30	Th.	♒	Neptune rises 11.59 A.	4 51	7 21	9 5	4 59	7 12	9 5	5 12	6 59	9 3	9 50	9 47	1800. — Friedrich Wöhler, German chemist.
212	31	Fr.	♓	☾ in ☋.	4 52	7 20	9 35	5 0	7 12	9 37	5 13	6 58	9 38	10 22	10 19	1829. — J. A. Meigs, American ethnologist.

MOON'S PHASES. (*Standard Time.*)	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	5 7 26 M.	5 6 26 M.	5 5 26 M.	5 4 26 M.
NEW MOON	12 0 16 M.	11 11 16 A.	11 10 16 A.	11 9 16 A.
FIRST QUARTER	18 7 20 A.	18 6 20 A.	18 5 20 A.	18 4 20 A.
FULL MOON	26 9 23 A.	26 8 23 A.	26 7 23 A.	26 6 23 A.

A BRIEF GUIDE TO THE DECADE.

July 4, 1880, fell on Sunday.	July 4, 1886, will fall on Sunday.
" 1881, " " Monday.	" 1887, " " " Monday.
" 1882, " " Tuesday.	" 1888, " " " Wednesday.
" 1883, " " Wednesday.	" 1889, " " " Thursday.
" 1884, " " Friday.	" 1890, " " " Friday.

"The tender speckled moth here dancing seen,
The vaulting grasshopper of glossy green,
And all-prolific summer's sporting train,
Their little lives by various pow'rs sustain."

BLOOMFIELD.

AUGUST, 1885.

*"The sky is a drinking-cup that was o'erturned of old,
And it poureth forth in the eyes of men its wine of airy gold.
We drink of the wine all day, till the last drop is drained up,
And are lighted off to bed by the jewels in the cup."*

R. H. STODDARD.

Mean time is used unless otherwise specified.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time.) Morn. H. M.	High Water, New York (Standard Time.) Eve. H. M.
213	1	Sa.	♓	Antares s. 7.40 A.	4 53	7 19	10 6	5 1	7 11	10 9	5 14	6 57	10 13	11 2	10 59
31.	9th Sunday after Trinity.			Day's Length:	14h. 24m.			14h. 7m.			13h. 43m.				
214	2	Su.	♓	Venus sets 8.19 A.	4 54	7 18	10 39	5 2	7 9	10 44	5 14	6 57	10 51	11 48	11 45
215	3	M.	♈	☽ 3d. Vega s. 9.42 A.	4 55	7 16	11 16	5 3	7 8	11 23	5 15	6 56	11 32	. . .	0 43
216	4	Tu.	♈	☌ ♆ ☾; ☌ ☿ ♃.	4 56	7 15	11 58	5 4	7 7	Morn.	5 16	6 55	Morn.	0 41	1 46
217	5	W.	♉	☌ ♄ μ Geminorum; ☌ ♃ ♀.	4 57	7 14	Morn.	5 5	7 6	0 6	5 16	6 54	0 18	1 49	2 57
218	6	Th.	♉	☿ gr. elong. E. 27°23′; ☌ ♂ ♄.	4 58	7 13	0 47	5 5	7 5	0 56	5 17	6 53	1 9	3 10	4 10
219	7	Fr.	♊	☿ in aphelion; ☌ ♄ ☾; ☌ ♂ ☾. ☊.	4 59	7 11	1 43	5 6	7 4	1 52	5 18	6 52	2 6	4 32	5 18
220	8	Sa.	♊	☌ ☿ ♀.	5 0	7 10	2 46	5 7	7 3	2 55	5 19	6 52	3 8	5 44	6 17
32.	10th Sunday after Trinity.			Day's Length:	14h. 8m.			13h. 54m.			13h. 32m.				
221	9	Su.	♋	☾ in perigee.	5 1	7 9	3 55	5 8	7 2	4 3	5 19	6 51	4 15	6 47	7 10
222	10	M.	♋	● 10th. Mars rises 1.48 M.	5 2	7 7	Sets.	5 9	7 0	Sets.	5 20	6 50	Sets.	7 43	8 1
223	11	Tu.	♌	☌ ♃ ☾.	5 3	7 6	7 46	5 10	6 59	7 44	5 21	6 49	7 40	8 35	8 48
224	12	W.	♌	☌ ☿ ☾; ☌ ♀ ☾.	5 4	7 4	8 22	5 11	6 58	8 22	5 21	6 48	8 21	9 24	9 34
225	13	Th.	♍	☌ ♅ ☾: ☾ in ☊.	5 5	7 3	8 56	5 12	6 56	8 58	5 22	6 47	9 0	10 9	10 22
226	14	Fr.	♍	Altair s. 10.10 A.	5 6	7 2	9 30	5 13	6 55	9 34	5 23	6 45	9 38	10 56	11 7
227	15	Sa.	♎	Fomalhaut s. 1.16 M.	5 7	7 0	10 4	5 14	6 54	10 10	5 24	6 44	10 17	11 47	11 54
33.	11th Sunday after Trinity.			Day's Length:	13h. 51m.			13h. 38m.			13h. 19m.				
228	16	Su.	♎	Jupiter sets 7.37 A.	5 8	6 59	10 39	5 15	6 53	10 46	5 24	6 43	10 56	. . .	0 40
229	17	M.	♎	☾ 17th. Markab s. 1.16 M.	5 10	6 57	11 17	5 15	6 51	11 25	5 25	6 42	11 37	0 48	1 41
230	18	Tu.	♏	□ ♆ ☉.	5 11	6 56	11 58	5 16	6 50	Morn.	5 26	6 41	Morn.	1 50	2 46
231	19	W.	♏	☌ ♀ β Virginis.	5 12	6 54	Morn.	5 17	6 49	0 7	5 26	6 40	0 20	3 2	3 50
232	20	Th.	♐	☿ stationary. ☋.	5 13	6 53	0 42	5 18	6 47	0 51	5 27	6 39	1 5	4 14	4 49
233	21	Fr.	♐	☾ in apogee.	5 14	6 51	1 30	5 19	6 46	1 39	5 27	6 38	1 53	5 16	5 39
234	22	Sa.	♐	Saturn rises 1.2 M.	5 15	6 50	2 21	5 20	6 44	2 30	5 28	6 36	2 42	6 4	6 22
34.	12th Sunday after Trinity.			Day's Length:	13h. 32m.			13h. 22m.			13h. 6m.				
235	23	Su.	♑	Algenib s. 2.0 M.	5 16	6 48	3 15	5 21	6 43	3 23	5 29	6 35	3 35	6 44	6 58
236	24	M.	♑	☌ ♅ ♀.	5 17	6 46	4 11	5 22	6 42	4 18	5 30	6 34	4 27	7 19	7 27
237	25	Tu.	♒	○ 25th. Uranus sets 7.47 A.	5 18	6 45	Rises.	5 23	6 40	Rises.	5 30	6 33	Rises.	7 50	7 54
238	26	W.	♒	Polaris s. 2.58 M.	5 19	6 43	7 9	5 24	6 39	7 8	5 31	6 32	7 6	8 21	8 27
239	27	Th.	♒	☌ ☿ ♃; ☿ gr. Hel. Lat. S.: ☾ in ☋.	5 20	6 41	7 39	5 25	6 38	7 40	5 31	6 30	7 40	8 51	8 54
240	28	Fr.	♓	♆ stationary.	5 21	6 40	8 10	5 26	6 36	8 13	5 32	6 29	8 15	9 19	9 25
241	29	Sa.	♓	Achernar s. 3.3 M.	5 22	6 38	8 43	5 26	6 34	8 47	5 33	6 28	8 53	9 54	10 0
35.	13th Sunday after Trinity.			Day's Length:	13h. 14m.			13h. 6m.			12h. 54m.				
242	30	Su.	♈	Neptune rises 9.58 A.	5 23	6 37	9 18	5 27	6 33	9 24	5 33	6 27	9 33	10 35	10 40
243	31	M.	♈	☌ ♆ ☾.	5 24	6 35	9 57	5 28	6 31	10 4	5 34	6 25	10 15	11 23	11 29

Eighth Month. *31 Days.*

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1778. — John C. Warren, American anatomist.
1779. — Lorenz Oken, German naturalist.
1818. — Maria Mitchell, American astronomer.

1773. — Jeremiah Day, American mathematician.

1802. — N. H Abel, Norwegian mathematician.
1766. — William H. Wollaston, Eng. physicist.
1727 — James Bowdoin, American physicist.
1799. — Benjamin Silliman, American chemist.

1822. — J. A. W. Moleschott, Dutch physiologist.
1779. — Joachim Barrande, Bohemian paleontol.
1814. — Jeffries Wyman, American physiologist.
1814. — A. J. Ångström, Swedish astronomer.
1819. — George G. Stokes, Irish physicist.
1777. — H. C. Oersted, Danish physicist.

1743. — A. L. Lavoisier, French chemist.
1821. — A. Cayley, English mathematician.
1699. — B. J. Jussieu, French botanist.
1646. — J. Flamsteed, English astronomer.
1793. — Elisha Mitchell, American naturalist.
1794. — Bernhard Studer, Swiss geologist.
1820. — John Tyndall, English physicist.
1647. — D. Papin, French physicist.
1796. — Baden Powell, English mathematician.

1769. — George Cuvier, French naturalist.
1784. — Joseph E. Worcester, American geographer and philologist.

1749. — Wilhelm von Goethe, Ger. poet and nat.
1810. — O. M. Mitchel, Amer. astronomer.
1779. — J. J. Berzelius, Swedish chemist.
1809. — Oliver Wendell Holmes, Am. physiol.

Oswald Heers, Swiss naturalist.
1821. — H. L. F. Helmholtz, German physicist.

MOON'S PHASES. (*Standard Time.*)

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	3 4 56 A.	3 3 56 A.	3 2 56 A.	3 1 56 A.
NEW MOON	10 7 14 M.	10 6 14 M.	10 5 14 M.	10 4 14 M.
FIRST QUARTER	17 8 47 M.	17 7 47 M.	17 6 47 M.	17 5 47 M.
FULL MOON	25 0 25 A.	25 11 25 M.	25 10 25 M.	25 9 25 M.

A BRIEF GUIDE TO THE DECADE.

Aug. 1, 1880, fell on Sunday.	Aug. 1, 1886, will fall on Sunday.
" 1881, " " Monday.	" 1887, " " " Monday.
" 1882, " " Tuesday.	" 1888, " " " Wednesday.
" 1883, " " Wednesday.	" 1889, " " " Thursday.
" 1884, " " Friday.	" 1890, " " " Friday.

“ Earth's increase, foison plenty,
Barns and garners never empty,
Vines with clustering bunches growing,
Plants with goodly burthen bowing;
Spring come to you at the farthest
In the very end of harvest!” SHAKSPEARE.

SEPTEMBER, 1885.

“ The wind-flower and the violet, they perished long ago,
And the brier-rose and the orchis died amid the summer glow;
But on the hill the golden-rod, and the aster in the wood,
And the yellow sunflower by the brook in autumn beauty stood.”
BRYANT.

Mean time is used unless otherwise specified.

Ninth Month. 30 Days.

Day of Year	Day of Month	Day of Week	Moon's Constellation	PLANETARY PHENOMENA	Boston Sun Rises H. M.	Boston Sun Sets H. M.	Boston Moon Rises H. M.	Washington Sun Rises H. M.	Washington Sun Sets H. M.	Washington Moon Rises H. M.	Charleston, S.C. Sun Rises H. M.	Charleston, S.C. Sun Sets H. M.	Charleston, S.C. Moon Rises H. M.	High Water, New York (Standard Time) Morn. H. M.	High Water, New York Eve. H. M.
244	1	Tu.	♉	1st. Hamel s. 3.18 M.	5 25	6 33	10 42	5 29	6 29	10 51	5 35	6 24	11 3	. . .	0 18
245	2	W.	♉	2d. ☌ ☿ ☉ inferior.	5 26	6 31	11 34	5 30	6 28	11 43	5 35	6 23	11 57	0 30	1 23
246	3	Th.	♊	☌ ♄ ☾.	5 27	6 30	Morn.	5 31	6 26	Morn.	5 36	6 21	Morn.	1 45	2 38
247	4	Fr.	♊	☌ ♂ ☾.	5 29	6 28	0 32	5 32	6 25	0 41	5 37	6 20	0 55	3 10	3 54
248	5	Sa.	♋	Venus sets 7.41 A.	5 30	6 26	1 36	5 33	6 23	1 45	5 37	6 19	1 57	4 29	5 2
36.	14th Sunday after Trinity.			Day's Length:	12h. 53m.			12h. 48m.			12h. 39m.				
249	6	Su.	♋	☾ in perigee.	5 31	6 24	2 45	5 34	6 22	2 52	5 38	6 17	3 3	5 37	6 0
250	7	M.	♌	☌ ☿ ☾.	5 32	6 23	3 56	5 35	6 20	4 2	5 38	6 16	4 10	6 34	6 53
251	8	Tu.	♌	● 8th. ☌ ♃ ☾: ☌ ♃ ☉.	5 33	6 21	Sets.	5 35	6 19	Sets.	5 39	6 15	Sets.	7 25	7 41
252	9	W.	♌	☌ ♅ ☾: ☾ in ☊.	5 34	6 19	6 51	5 36	6 17	6 52	5 40	6 13	6 52	8 11	8 32
253	10	Th.	♍	Algol s. 3.42 M.	5 35	6 18	7 25	5 37	6 15	7 28	5 40	6 12	7 31	8 54	9 14
254	11	Fr.	♍	☌ ♀ ☾.	5 36	6 16	7 59	5 38	6 14	8 4	5 41	6 11	8 10	9 38	9 55
255	12	Sa.	♎	☿ stationary; ♀ in ☋.	5 37	6 14	8 35	5 39	6 12	8 41	5 42	6 9	8 50	10 23	10 39
37.	15th Sunday after Trinity.			Day's Length:	12h. 34m.			12h. 31m.			12h. 25m.				
256	13	Su.	♎	Mars rises 1.16 M.	5 38	6 12	9 13	5 40	6 11	9 21	5 43	6 8	9 32	11 8	11 25
257	14	M.	♏	Vega s. 6.57 A.	5 39	6 11	9 54	5 41	6 9	10 3	5 43	6 7	10 15	11 59	. . .
258	15	Tu.	♏	☾ 15th. ☿ in ☊; ☿ gr.el.W.17°52′.	5 40	6 9	10 37	5 42	6 8	10 46	5 44	6 5	11 0	0 18	0 53
259	16	W.	♏	16th. Jupiter rises 5.16 M.	5 41	6 7	11 24	5 42	6 6	11 33	5 44	6 4	11 47	1 19	1 54
260	17	Th.	♐	Saturn rises 11.26 A.	5 42	6 5	Morn.	5 43	6 4	Morn.	5 45	6 3	Morn.	2 29	2 56
261	18	Fr.	♐	☾ in apogee.	5 43	6 3	0 14	5 44	6 3	0 23	5 46	6 2	0 36	3 38	3 58
262	19	Sa.	♑	Uranus sets 6.14 A.	5 44	6 2	1 7	5 45	6 1	1 15	5 46	6 0	1 27	4 37	4 49
38.	16th Sunday after Trinity.			Day's Length:	12h. 14m.			12h. 14m.			12h. 12m.				
263	20	Su.	♑	☿ in perihelion.	5 46	6 0	2 2	5 46	6 0	2 9	5 47	5 59	2 19	5 24	5 33
264	21	M.	♑	Altair s. 7.41 A.	5 47	5 58	2 59	5 47	5 58	3 5	5 48	5 58	3 12	6 5	6 11
265	22	Tu.	♒	☉ enters ♎; autumn begins.	5 48	5 56	3 58	5 48	5 57	4 2	5 48	5 56	4 7	6 40	6 52
266	23	W.	♒	○ 23d. ☾ in ☋.	5 49	5 55	4 58	5 49	5 55	5 1	5 49	5 55	5 3	7 15	7 23
267	24	Th.	♓	24th. ♂ in *Praesepe.*	5 50	5 53	Rises.	5 50	5 53	Rises.	5 50	5 53	Rises.	7 41	7 56
268	25	Fr.	♓	Neptune rises 8.16 A.	5 51	5 51	6 44	5 51	5 51	6 48	5 50	5 52	6 52	8 17	8 30
269	26	Sa.	♈	☌ ♅ ☉.	5 52	5 49	7 18	5 52	5 50	7 24	5 51	5 51	7 31	8 54	9 7
39.	17th Sunday after Trinity.			Day's Length:	11h. 55m.			11h. 56m.			11h. 57m.				
270	27	Su.	♈	☌ ☿ ♃.	5 53	5 48	7 57	5 52	5 48	8 4	5 52	5 49	8 14	9 34	9 47
271	28	M.	♉	☌ ♆ ☾.	5 54	5 46	8 41	5 53	5 47	8 49	5 52	5 48	9 1	10 18	10 34
272	29	Tu.	♉	Fomalhaut s. 10.15 A.	5 55	5 44	9 30	5 54	5 45	9 39	5 53	5 47	9 52	11 6	11 30
273	30	W.	♉	☿ gr. Hel. Lat. N.	5 56	5 43	10 25	5 55	5 43	10 34	5 54	5 45	10 48	. . .	0 3

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1806. — Stephen Alexander, Amer. astronomer.

1814. — James J. Sylvester, Eng. mathematician.
1766. — J. Dalton, English chemist.
1826. — T. Sterry Hunt, Canadian chemist.

1811. — J. M. Gilliss, American astronomer.
1813. — John Cassin, American naturalist.
1707. — G. L. L. Buffon, French naturalist.
1837. — Raphael Pumpelly, American geologist.
1771. — Mungo Park, Scotch explorer.
1839. — Charles S. Peirce, Amer. mathematician.
1798. — F. E. Neumann, German mineralogist.
1778. — H. M. D. Blainville, French zoölogist.
1811. — James Hall, American paleontologist.

1778. — J. G. A. Chevallier, French optician.
1769. — Alexander Humboldt, German savant.

1732. — A. M. Legendre, French mathematician.
1819. — J. B. L. Foucault, French physicist.
1796. — Richard Harlan, American zoölogist.
1813. — C. H. F. Peters, American astronomer.

1809. — D. Houghton, American geologist.
1791. — M. Faraday, English physicist.
1791. — J. F. Encke, German astronomer.
1819. — H. L. Fizeau, French physicist.
1750. — Abraham Gottlob Werner, Ger. geol.
1798. — Elie de Beaumont, French geologist.

1719. — A. G. Kästner, German mathematician.
1824. — Benj. A. Gould, American astronomer.
1807. — Arnold Guyot, Swiss and Amer. geog.

MOON'S PHASES. *(Standard Time.)*

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	2 0 15 M.	1 11 15 A.	1 10 15 A.	1 9 15 A.
NEW MOON	8 1 44 A.	8 2 44 A.	8 1 44 A.	8 0 43 A.
FIRST QUARTER	16 1 15 M.	16 0 15 M.	15 11 15 A.	15 10 15 A.
FULL MOON	24 2 55 M.	24 1 55 M.	24 0 55 M.	24 11 55 A.

A BRIEF GUIDE TO THE DECADE.

Sept. 1, 1880, fell on Wednesday.	Sept. 1, 1886, will fall on Wednesday.
" 1881, " " Thursday.	" 1887, " " " Thursday.
" 1882, " " Friday.	" 1888, " " " Saturday.
" 1883, " " Saturday.	" 1889, " " " Sunday.
" 1884, " " Monday.	" 1890, " " " Monday.

"The swamp-oak, with his royal purple on,
Glares red as blood across the sinking sun,
The chestnuts, lavish of their long-hid gold,
To the faint summer, beggard now and old,
Pour back the sunshine hoarded 'neath her favoring eye."
LOWELL.

OCTOBER, 1885.

"*Thou blossom, bright with autumn dew,*
And colored with the heaven's own blue,
That openest when the quiet light
Succeeds the keen and frosty night;
Thou waitest late, and com'st alone,
When woods are bare and birds have flown." BRYANT.

Mean time is used unless otherwise specified.

Tenth Month. 31 Days.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Latitude of Boston. Sun Rises. H. M.	Sun Sets. H. M.	Moon Rises. H. M.	Latitude of Washington. Sun Rises. H. M.	Sun Sets. H. M.	Moon Rises. H. M.	Latitude of Charleston, S.C. Sun Rises. H. M.	Sun Sets. H. M.	Moon Rises. H. M.	High Water, New York. (Standard Time.) Morn. H. M.	Eve. H. M.	BIRTHDAYS OF SCIENTIFIC CELEBRITIES.
274	1	Th.	♊	☽ 1st. □ ♄ ☉; ☌ ♄ ☾.	5 58	5 41	11 26	5 56	5 42	11 35	5 54	5 44	11 48	0 38	1 9	1814.—H. A. E. A. Faye, French astronomer.
275	2	Fr.	♊	Venus sets 7.13 A.	5 59	5 39	Morn.	5 57	5 40	Morn.	5 55	5 43	Morn.	1 56	2 22	
276	3	Sa.	♋	☌ ♂ ☾; ☾ in perigee.	6 0	5 37	0 32	5 58	5 39	0 40	5 56	5 42	0 52	3 17	3 36	
40. 18th Sunday after Trinity.				Day's Length:	11h. 35m.			11h. 38m.			11h. 44m.					
277	4	Su.	♋	☌ ♅ ☿.	6 1	5 36	1 40	5 59	5 37	1 46	5 56	5 40	1 56	4 28	4 43	1732.—N. Maskelyne, English astronomer.
278	5	M.	♌	Fomalhaut s. 9.52 A.	6 2	5 34	2 50	6 0	5 36	2 55	5 57	5 39	3 0	5 26	5 44	1789.—William Scoresby, English explorer.
279	6	Tu.	♌	☌ ♃ ☾.	6 3	5 32	4 0	6 1	5 34	4 3	5 58	5 38	4 5	6 15	6 35	1803.—H. W. Dove, German meteorologist.
280	7	W.	♍	● 7th. ☌ ♅ ☾; ☌ ☿ ☾; ☾ in ☊.	6 4	5 31	5 8	6 2	5 33	5 9	5 59	5 36	5 8	7 3	7 23	
281	8	Th.	♍	8th. Mars rises 0.52 M.	6 5	5 29	Sets.	6 3	5 31	Sets.	6 0	5 35	Sets.	7 48	8 6	
282	9	Fr.	♎	Markab s. 9.44 A.	6 7	5 27	6 30	6 4	5 30	6 36	6 0	5 34	6 44	8 29	8 49	1801.—A. A. de la Rive, Swiss physicist.
283	10	Sa.	♎	Algenib s. 10.48 A.	6 8	5 25	7 8	6 5	5 28	7 15	6 1	5 33	7 25	9 12	9 32	1731.—H. Cavendish, English physicist.
41. 19th Sunday after Trinity.				Day's Length:	11h. 15m.			11h. 21m.			11h. 29m.					1792.—C. G. Gmelin, German chemist.
284	11	Su.	♏	☌ ♀ ☾.	6 9	5 24	7 47	6 6	5 27	7 55	6 2	5 31	8 7	9 53	10 15	1802.—Hugh Miller, Scotch geologist.
285	12	M.	♏	Jupiter rises 4.2 M.	6 10	5 22	8 29	6 7	5 25	8 38	6 2	5 30	8 51	10 34	11 0	1827.—J. P. Cooke, American chemist.
286	13	Tu.	♏	Polaris s. 11.45 A.	6 11	5 21	9 16	6 8	5 24	9 25	6 3	5 29	9 39	11 17	11 49	1788.—Sir Edward Sabine, Irish geographer.
287	14	W.	♐	Achernar s. 11.58 A.	6 13	5 19	10 6	6 9	5 22	10 15	6 4	5 28	10 28	. . .	0 3	1810.—J. A. F. Plateau, Belgian physicist.
288	15	Th.	♐	☾ 15th. ☌ ☿ ☉ superior.	6 14	5 17	10 58	6 10	5 21	11 7	6 5	5 26	11 19	0 45	0 54	1608.—Evangelista Torricelli, Italian physicist.
289	16	Fr.	♑	♀ in aphelion; ☾ in apogee.	6 15	5 16	11 52	6 11	5 20	Morn.	6 5	5 25	Morn.	1 47	1 48	1803.—Robert Stephenson, English engineer.
290	17	Sa.	♑	Hamel s. 0.17 M.	6 16	5 14	Morn.	6 12	5 18	0 0	6 6	5 24	0 11	2 49	2 45	1814.—Hanns Bruno Geinitz, German geologist.
42. 20th Sunday after Trinity				Day's Length:	10h. 56m.			11h. 4m.			11h. 16m.					
291	18	Su.	♑	Algol s. 1.13 M.	6 17	5 13	0 48	6 13	5 17	0 54	6 7	5 23	1 3	3 45	3 42	
292	19	M.	♒	Saturn rises 9.24 A.	6 18	5 11	1 46	6 14	5 15	1 51	6 8	5 22	1 57	4 30	4 37	
293	20	Tu.	♒	♄ stationary; ☾ in ☋.	6 19	5 10	2 45	6 15	5 14	2 48	6 8	5 21	2 52	5 12	5 21	1632.—Sir Christopher Wren, English architect.
294	21	W.	♓	♄ in perihelion; ☌ ♃ β Virginis.	6 21	5 8	3 46	6 16	5 13	3 47	6 9	5 20	3 48	5 54	6 3	
295	22	Th.	♓	Aldebaran s. 2.26 M.	6 22	5 7	4 49	6 17	5 11	4 49	6 10	5 19	4 47	6 33	6 44	1729.—J. R. Forster, German voyager.
296	23	Fr.	♓	○ 23d. ☿ in ☋.	6 23	5 5	5 53	6 18	5 10	5 51	6 11	5 18	5 46	7 12	7 27	1632.—A. v. Leeuwenhoek, Dutch microscopist.
297	24	Sa.	♈	Uranus rises 4.12 M.	6 24	5 4	Rises.	6 19	5 9	Rises.	6 11	5 17	Rises.	7 53	8 10	1808.—Bernhard Cotta, German geologist.
43. 21st Sunday after Trinity.				Day's Length:	10h. 37m.			10h. 47m.			11h. 3m.					
298	25	Su.	♈	☌ ♆ ☾.	6 25	5 2	6 37	6 20	5 7	6 45	6 12	5 15	6 57	8 35	8 55	1781.—Chester Dewey, American botanist.
299	26	M.	♉	Capella s. 2.49 M.	6 26	5 1	7 25	6 21	5 6	7 34	6 13	5 14	7 47	9 18	9 44	1792.—Franklin Bache, American chemist.
300	27	Tu.	♉	Rigel s. 2.46 M.	6 28	5 0	8 20	6 22	5 5	8 29	6 14	5 13	8 43	10 5	10 38	1728.—Capt. Cook, English navigator.
301	28	W.	♊	☌ ♄ ☾; ☾ in perigee.	6 29	4 58	9 21	6 24	5 4	9 30	6 15	5 12	9 43	10 56	11 39	1806.—Alphonse de Candolle, Swiss botanist.
302	29	Th.	♊	Neptune rises 6.0 A.	6 30	4 57	10 25	6 25	5 3	10 33	6 16	5 12	10 45	11 53	. . .	1656.—E. Halley, English astronomer.
303	30	Fr.	♋	☽ 30th. Canopus s. 3.46 M.	6 32	4 55	11 31	6 26	5 1	11 38	6 16	5 11	11 48	0 48	0 56	1831.—O. C. Marsh, American paleontologist.
304	31	Sa.	♋	☌ ♂ ☾.	6 33	4 54	Morn.	6 27	5 0	Morn.	6 17	5 10	Morn.	2 3	2 5	1783.—K. W. G. Kastner, German chemist.

MOON'S PHASES. ***(Standard Time.)***

	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
LAST QUARTER	1 6 29 M.	1 5 29 M.	1 4 29 M.	1 3 29 M.
NEW MOON	8 2 31 M.	8 1 31 M.	8 0 31 M.	7 11 31 A.
FIRST QUARTER	15 8 20 A.	15 7 20 A.	15 6 20 A.	15 5 20 A.
FULL MOON	23 4 22 A.	23 3 22 A.	23 2 22 A.	23 1 22 A.
LAST QUARTER	30 0 58 A.	30 11 58 M.	30 10 58 M.	30 9 58 M.

A BRIEF GUIDE TO THE DECADE.

Oct. 1, 1880, fell on Friday.	Oct. 1, 1886, will fall on Friday.
" 1881, " " Saturday.	" 1887, " " " Saturday.
" 1882, " " Sunday.	" 1888, " " " Monday.
" 1883, " " Monday.	" 1889, " " " Tuesday.
" 1884, " " Wednesday.	" 1890, " " " Wednesday.

"The sobered robin, hunger-silent now,
Seeks cedar-berries blue, his autumn cheer;
The squirrel, on the shingly shagbark's bough,
Now saws, now lists with downward eye and ear."

LOWELL.

NOVEMBER, 1885.

"On my cornice linger the ripe black grapes ungathered;
Children fill the groves with the echoes of their glee,
Gathering tawny chestnuts, and shouting when beside them
Drops the heavy fruit of the tall black-walnut tree."

BRYANT.

Eleventh Month. 30 Days.

Mean time is used unless otherwise specified.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time) Morn. H. M.	High Water, New York (Standard Time) Eve. H. M.
44.	22d Sunday after Trinity.			Day's Length:	10h. 18m.			10h. 31m.			10h. 51m.				
305	1	Su.	♌	Sirius s. 3.57 M.	6 34	4 52	0 39	6 28	4 59	0 44	6 18	5 9	0 51	3 12	3 17
306	2	M.	♌	☿ in aphelion.	6 35	4 52	1 47	6 29	4 58	1 51	6 19	5 8	1 54	4 14	4 25
307	3	Tu.	♍	☌ ♃ ☾ : ☌ ♂ ☾ : ☾ in ☊.	6 36	4 50	2 54	6 30	4 57	2 56	6 20	5 7	2 57	5 9	5 22
308	4	W.	♍	Venus sets 7.16 A.	6 38	4 49	4 1	6 31	4 56	4 1	6 21	5 6	3 59	6 0	6 14
309	5	Th.	♍	Fomalhaut s. 7.50 A.	6 39	4 48	5 6	6 32	4 55	5 4	6 22	5 6	4 59	6 47	7 2
310	6	Fr.	♎	● 6th. Markab s. 7.53 A.	6 40	4 47	6 11	6 34	4 54	6 7	6 23	5 5	6 0	7 29	7 47
311	7	Sa.	♎	☌ ☿ ☾.	6 42	4 46	Sets.	6 35	4 53	Sets.	6 24	5 4	Sets.	8 10	8 31
45.	23d Sunday after Trinity.			Day's Length:	10h. 2m.			10h. 16m.			10h. 38m.				
312	8	Su.	♏	♄ gr. Hel. Lat. S.	6 43	4 45	6 23	6 36	4 52	6 32	6 25	5 3	6 45	8 50	9 14
313	9	M.	♏	Mars rises 0.15 M.	6 44	4 44	7 8	6 37	4 51	7 17	6 26	5 2	7 31	9 27	9 55
314	10	Tu.	♐	☌ ♀ ☾. ☋.	6 45	4 42	7 56	6 38	4 50	8 5	6 26	5 1	8 19	10 4	10 37
315	11	W.	♐	Algenib s. 8.42 A.	6 47	4 41	8 47	6 39	4 49	8 56	6 27	5 1	9 9	10 41	11 20
316	12	Th.	♐	☾ in apogee.	6 48	4 40	9 40	6 40	4 48	9 48	6 28	5 0	10 0	11 18	. . .
317	13	Fr.	♑	Polaris s. 9.43 A.	6 49	4 40	10 35	6 41	4 47	10 42	6 29	5 0	10 52	0 7	11 58*
318	14	Sa.	♑	☾ 14th. Achernar s. 9.56 A.	6 51	4 39	11 31	6 42	4 47	11 37	6 30	4 59	11 44	0 58	0 44
46.	24th Sunday after Trinity.			Day's Length:	9h. 46m.			10h. 2m.			10h. 28m.				
319	15	Su.	♒	Jupiter rises 2.19 M.	6 52	4 38	Morn.	6 44	4 46	Morn.	6 31	4 59	Morn.	1 48	1 39
320	16	M.	♒	♄ Ψ ☌ : ☾ in ☋.	6 53	4 37	0 29	6 45	4 45	0 33	6 32	4 58	0 38	2 38	2 33
321	17	Tu.	♒	Hamel s. 10.11 A.	6 54	4 36	1 29	6 46	4 45	1 31	6 33	4 58	1 34	3 32	3 27
322	18	W.	♓	Algol s. 11.7 A.	6 55	4 35	2 31	6 47	4 44	2 32	6 34	4 57	2 31	4 23	4 22
323	19	Th.	♓	Aldebaran s. 0.36 M.	6 57	4 35	3 35	6 48	4 43	3 34	6 35	4 57	3 30	5 12	5 17
324	20	Fr.	♈	Saturn rises 7.14 A.	6 58	4 34	4 40	6 49	4 43	4 37	6 36	4 56	4 31	5 59	6 9
325	21	Sa.	♈	○ 22d. ☌ Ψ ☾.	6 59	4 33	5 47	6 50	4 42	5 42	6 36	4 56	5 34	6 47	7 2
47.	25th Sunday after Trinity.			Day's Length:	9h. 33m.			9h. 51m.			10h. 19m.				
326	22	Su.	♉	Uranus rises 2.25 M.	7 0	4 33	Rises.	6 51	4 42	Rises.	6 37	4 56	Rises.	7 33	7 55
327	23	M.	♉	☿ gr. Hel. Lat. S.	7 2	4 32	6 8	6 52	4 41	6 17	6 38	4 55	6 31	8 19	8 48
328	24	Tu.	♊	☌ ♄ ☾ : ☾ in perigee. ☊.	7 3	4 32	7 9	6 54	4 41	7 18	6 39	4 55	7 32	9 7	9 43
329	25	W.	♊	Capella s. 0.51 M.	7 4	4 31	8 14	6 54	4 40	8 23	6 40	4 55	8 36	9 58	10 39
330	26	Th.	♋	Rigel s. 0.48 M.	7 5	4 31	9 21	6 55	4 40	9 29	6 41	4 54	9 39	10 47	11 40
331	27	Fr.	♋	Canopus s. 1.56 M.	7 6	4 30	10 30	6 56	4 39	10 36	6 42	4 54	10 44	11 42	. . .
332	28	Sa.	♌	☽ 28th. Neptune sets 5.55 M.	7 7	4 30	11 39	6 57	4 39	11 43	6 42	4 54	11 48	0 45	0 39
48.	1st Sunday in Advent.			Day's Length:	9h. 21m.			9h. 41m.			10h. 11m.				
333	29	Su.	♌	☌ ♂ ☾.	7 8	4 29	Morn.	6 58	4 39	Morn.	6 43	4 54	Morn.	1 49	1 47
334	30	M.	♌	☿ gr. el. E. 21° 21′: ☌ ♃ ☾ : ☾ in ☊.	7 9	4 29	0 47	6 59	4 39	0 49	6 44	4 54	0 51	2 53	2 54

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1810.—Gen. A. A. Humphreys, Am. engineer.
1815.—G. Boole, English mathematician.
1786.—E. F. Germar, German naturalist.
1744.—Johann Bernouilli, Swiss astronomer.
1798.—Karl Kreil, Austrian meteorologist.
1809.—R. H. Kohlrausch, German physicist.
1818.—E. H. du Bois-Reymond, Ger. physicist.

1781.—G. A. A. Plana, Italian mathematician.
1748.—C. L. Berthollet, French physicist.
1805.—Charles Pickering, American naturalist.
1743.—C. P. Thunberg, Swedish naturalist.
1795.—Thaddeus W. Harris, Am. entomologist.
1842.—Lord Rayleigh, English physicist.
1797—Sir Charles Lyell, English geologist.

1738.—F. W. Herschel, English astronomer.
1793.—M. Chasles, French mathematician.
1717.—J. le R. d'Alembert, French geometer.
1790.—A. F. Moebius, German astronomer.
1810.—Asa Gray, American botanist
1821.—F. F. E. Brünnow, Amer. astronomer
1832.—N. A. E. Nordenskiöld, Finnish traveller.

1819.—Joseph D. Whitney, American geologist.

1796.—A. von Ettingshausen, Ger. physicist.
1817.—Charles A. Wurtz, French chemist.
1701.—A. Celsius, Swedish physicist.
1734.—Johann A. Euler, Russ. mathematician.

* Second morning tide.

MOON'S PHASES.
(Standard Time.)

	Eastern. d.	h.	m.		Central. d.	h.	m.		Mountain. d.	h.	m.		Pacific. d.	h.	m.	
New Moon	6	4	3	A.	6	3	3	A.	6	2	3	A.	6	1	3	A.
First Quarter	14	4	59	A.	14	3	59	A.	14	2	59	A.	14	1	59	A.
Full Moon	22	4	30	M.	22	3	30	M.	22	2	30	M.	22	1	30	M.
Last Quarter	28	8	57	A.	28	7	57	A.	28	6	57	A.	28	5	57	A.

A BRIEF GUIDE TO THE DECADE.

Nov. 1, 1880, fell on Monday.	Nov. 1, 1886, will fall on Monday
" 1881, " " Tuesday.	" 1887, " " " Tuesday.
" 1882, " " Wednesday.	" 1888, " " " Thursday
" 1883, " " Thursday.	" 1889, " " " Friday.
" 1884, " " Saturday.	" 1890, " " " Saturday

"Within the hall are song and laughter,
The cheeks of Christmas grow red and jolly,
And sprouting is every corbel and rafter
With the lightsome green of ivy and holly."
LOWELL.

DECEMBER, 1885.

"*The snow-bird twittered on the beechen bough,*
And 'neath the hemlock, whose thick branches bent
Beneath its bright cold burden, and kept dry
A circle, on the earth, of withered leaves,
The partridge found a shelter. Through the snow
The rabbit sprang away."
BRYANT.

Mean time is used unless otherwise specified.

Twelfth Month. 31 Days.

Day of Year.	Day of Month.	Day of Week.	Moon's Constellation.	PLANETARY PHENOMENA.	Boston Sun Rises. H. M.	Boston Sun Sets. H. M.	Boston Moon Rises. H. M.	Washington Sun Rises. H. M.	Washington Sun Sets. H. M.	Washington Moon Rises. H. M.	Charleston, S.C. Sun Rises. H. M.	Charleston, S.C. Sun Sets. H. M.	Charleston, S.C. Moon Rises. H. M.	High Water, New York (Standard Time) Morn. H. M.	High Water, New York (Standard Time) Eve. H. M.
335	1	Tu.	♍	☌ ♅ ☾.	7 10	4 28	1 53	7 0	4 39	1 53	6 45	4 54	1 52	3 55	3 58
336	2	W.	♍	Venus sets 7.55 A.	7 11	4 28	2 57	7 1	4 38	2 55	6 46	4 54	2 52	4 54	4 58
337	3	Th.	♎	□ ♂ ☉.	7 12	4 28	4 0	7 2	4 38	3 57	6 47	4 54	3 50	5 44	5 54
338	4	Fr.	♎	Algenib s. 7.11 A.	7 13	4 28	5 1	7 3	4 38	4 56	6 47	4 54	4 47	6 32	6 47
339	5	Sa.	♏	Polaris s. 8.17 A.	7 14	4 28	6 1	7 4	4 38	5 55	6 48	4 54	5 44	7 15	7 33
49.	2d Sunday in Advent.			Day's Length:	9h. 13m.			9h. 33m.			10h. 5m.				
340	6	Su.	♏	● 6th. Achernar s. 8.29 A.	7 15	4 28	Sets.	7 5	4 38	Sets.	6 49	4 54	Sets.	7 56	8 18
341	7	M.	♏	☌ ☿ ☾. ☋.	7 16	4 28	5 48	7 6	4 38	5 57	6 50	4 54	6 11	8 33	8 59
342	8	Tu.	♐	♀ gr. el. E. 47°19′; ☌ ♃ η Virginis.	7 17	4 28	6 38	7 7	4 38	6 47	6 51	4 54	7 1	9 5	9 37
343	9	W.	♐	☿ stationary.	7 18	4 28	7 31	7 8	4 38	7 40	6 52	4 54	7 52	9 38	10 14
344	10	Th.	♑	☌ ♀ ☾; ☾ in apogee.	7 19	4 28	8 26	7 8	4 38	8 34	6 52	4 55	8 45	10 7	10 49
345	11	Fr.	♑	Mars rises 11.20 A.	7 20	4 28	9 21	7 9	4 39	9 27	6 53	4 55	9 36	10 36	11 26
346	12	Sa.	♑	☿ in ☊.	7 21	4 28	10 18	7 10	4 39	10 23	6 54	4 55	10 29	11 12	. . .
50.	3d Sunday in Advent.			Day's Length:	9h. 7m.			9h. 28m.			10h. 1m.				
347	13	Su.	♒	Algol s. 9.29 A.	7 21	4 28	11 16	7 11	4 39	11 19	6 54	4 55	11 23	0 4	11 56*
348	14	M.	♒	☾ 15th. ☾ in ☋.	7 22	4 29	Morn.	7 11	4 39	Morn.	6 55	4 55	Morn.	0 48	0 37
349	15	Tu.	♓	Jupiter rises 0.42 M.	7 23	4 29	0 16	7 12	4 40	0 17	6 56	4 56	0 18	1 40	1 28
350	16	W.	♓	Aldebaran s. 10.46 A.	7 23	4 29	1 16	7 13	4 40	1 16	6 56	4 56	1 14	2 37	2 26
351	17	Th.	♈	☿ in perihelion.	7 24	4 29	2 18	7 14	4 40	2 10	6 57	4 57	2 11	3 35	3 29
352	18	Fr.	♈	☌ ☿ ☉ inferior.	7 25	4 30	3 24	7 14	4 41	3 20	6 57	4 57	3 13	4 33	4 37
353	19	Sa.	♈	☌ ♆ ☾.	7 26	4 30	4 31	7 15	4 41	4 25	6 58	4 58	4 16	5 30	5 41
51.	4th Sunday in Advent.			Day's Length:	9h. 5m.			9h. 27m.			10h. 0m.				
354	20	Su.	♉	Saturn rises 5.6 A.	7 26	4 31	5 39	7 15	4 42	5 31	6 58	4 58	5 21	6 24	6 43
355	21	M.	♉	○ 21st. ☉ ents. ♑; winter begins;	7 26	4 31	Rises.	7 15	4 42	Rises.	6 59	4 59	Rises.	7 17	7 42
356	22	Tu.	♊	☾ in perigee. [♎; ☌ ♄ ☾.	7 27	4 32	5 54	7 16	4 43	6 3	6 59	4 59	6 17	8 6	8 38
357	23	W.	♊	Capella s. 10.57 A.	7 27	4 32	7 3	7 16	4 43	7 11	7 0	5 0	7 23	8 56	9 34
358	24	Th.	♋	Uranus rises 0.25 M.	7 28	4 33	8 14	7 17	4 44	8 21	7 0	5 0	8 30	9 45	10 29
359	25	Fr.	♋	Rigel s. 10.50 A.	7 28	4 34	9 26	7 17	4 44	9 31	7 1	5 1	9 37	10 34	11 26
360	26	Sa.	♌	□ ♃ ☉; ☍ ♄ ☉.	7 29	4 34	10 36	7 18	4 45	10 39	7 1	5 1	10 42	11 25	. . .
52.	Sunday after Christmas.			Day's Length:	9h. 6m.			9h. 28m.			10h. 0m.				
361	27	Su.	♌	☌ ♂ ☾; ☿ gr. H.L.N.; ☾ in ☊.	7 29	4 35	11 44	7 18	4 46	11 45	7 2	5 2	11 45	0 23	0 22
362	28	M.	♍	☽ 28th. ☌ ♃ ☾; ☌ ♅ ☾; □ ♅ ☉.	7 29	4 36	Morn.	7 18	4 46	Morn.	7 2	5 3	Morn.	1 21	1 21
363	29	Tu.	♍	☿ stationary.	7 29	4 36	0 49	7 19	4 47	0 48	7 2	5 4	0 45	2 26	2 24
364	30	W.	♎	☉ perigee.	7 30	4 37	1 53	7 19	4 48	1 50	7 3	5 4	1 45	3 30	3 29
365	31	Th.	♎	Neptune sets 3.41 M.	7 30	4 38	2 55	7 19	4 49	2 51	7 3	5 5	2 43	4 32	4 37

BIRTHDAYS OF SCIENTIFIC CELEBRITIES.

1838. — Cleveland Abbé, American meteorologist.
1818. — John L. LeConte, Amer. entomologist.

1778. — L. J. Gay-Lussac, French chemist.
1786. — J. G. Charpentier, Swiss geologist.
1804. — W. B. Rogers, American geologist.
1810. — Theodor Schwann, Belgian physiologist.
1781. — Sir David Brewster, Scotch chemist.
1731. — Erasmus Darwin, English physicist.

1743. — Sir Jos. Banks, English naturalist.
1816. — Ernst Werner Siemens, Eng. electrician.
1546. — Tycho Brahe, Danish astronomer.
1834. — Charles A. Young, American astronomer.
1493. — Paracelsus, Swiss chemist.
1778. — Sir Humphry Davy, English chemist.
1797. — Joseph Henry, American physicist.
1714. — John Winthrop, Am. math. and astron.
1787. — O. von Kotzebue, Russian navigator.
* Second morning tide.

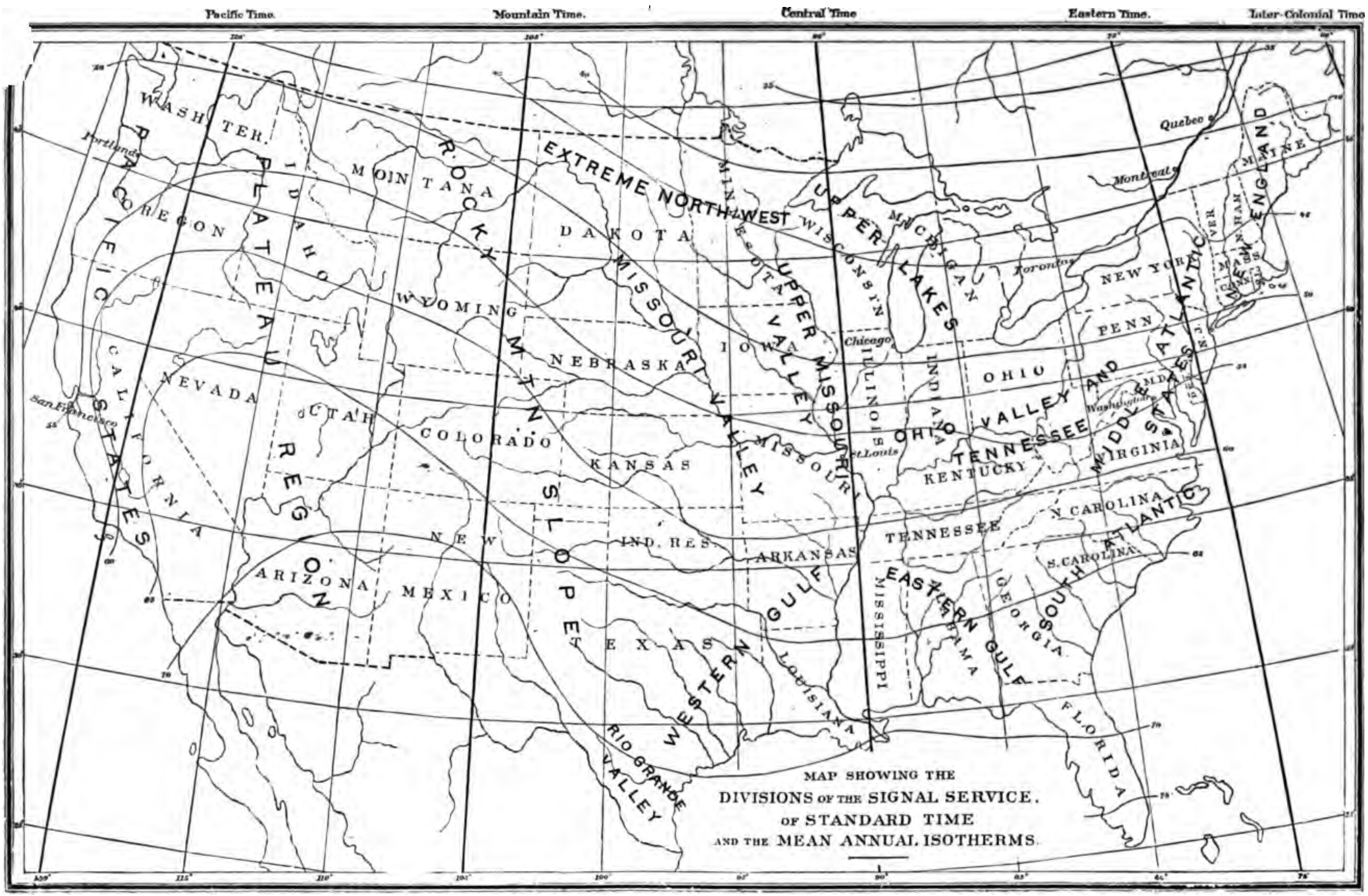
1805. — T. Graham, Scotch chemist.
1790. — J. F. Champollion, French Egyptologist
1792. — Charles Babbage, Eng. mathematician.
1818. — J. P. Joule, English physicist.
1813. — Joseph Lovering, American physicist.
1756. — B. G. Lacépède, French naturalist.

1571. — J. Kepler, German astronomer.
1822. — Louis Pasteur, French physiologist.
1818. — C. R. Fresenius, German chemist.
1796. — J. C. Poggendorff, German physicist.
1784. — Major S. H. Long, American explorer.
1796. — John E. Holbrook, American zoölogist.

MOON'S PHASES. (*Standard Time.*)	EASTERN. d. h. m.	CENTRAL. d. h. m.	MOUNTAIN. d. h. m.	PACIFIC. d. h. m.
NEW MOON	6 8 16 M.	6 7 16 M.	6 6 16 M.	6 5 16 M.
FIRST QUARTER	14 1 22 A.	14 0 22 A.	14 11 22 M.	14 10 22 M.
FULL MOON	21 3 58 A.	21 2 58 A.	21 1 58 A.	21 0 58 A.
LAST QUARTER	28 7 22 M.	28 6 22 M.	28 5 22 M.	28 4 22 M.

A BRIEF GUIDE TO THE DECADE.

Dec. 1, 1880, fell on Wednesday.	Dec. 1, 1886, will fall on Wednesday.
" 1881, " " Thursday.	" 1887, " " " Thursday.
" 1882, " " Friday.	" 1888, " " " Saturday.
" 1883, " " Saturday.	" 1889, " " " Sunday.
" 1884, " " Monday.	" 1890, " " " Monday.



MAP SHOWING THE DIVISIONS OF THE SIGNAL SERVICE, OF STANDARD TIME AND THE MEAN ANNUAL ISOTHERMS.

THERE are but few families of the floral kingdom that are more interesting, as regards their life-history and their physical peculiarities, than the ORCHIDS. Until very recent years, they were little known in this country, and even now they are not fully appreciated or understood, save by botanists and a small number of floriculturists. On the Continent of Europe, however, their curious shapes, their exquisite beauty, and the delightful fragrance of the rarer species of some of these plants have attracted many observers; and it may even be said of the orchids that there they are looked upon as "THE ELITE OF THE FLORAL KINGDOM."

The natural habitat of the orchid is chiefly in the tropics, and by far the most beautiful of the species comes from the East Indies. Certain species are found growing in all warm and moist latitudes, while a few grow in this country as far north as Canada.

There are two general classes of orchids: one class, called the Epiphytes, embraces those plants which live upon other plants, branches of trees, on blocks of dry wood, and even upon stone, deriving sustenance from the air; the other class, the Terrestrial, few in number, include the plants which grow in and upon the soil. The most beautiful and the most costly species of orchids belong to the first class. These two classes are distributed into seven orders, severally named in accordance with their individual peculiarities.

The magnificent volume, the full title of which is given above, is the most extensive attempt yet made to illustrate the orchids. It contains twenty-four reproductions, each life size, and resplendent in natural color. All of these illustrations were drawn by the artist from specimens found in American collections. Such collections are not numerous, indeed, they are exceedingly rare, and have cost their several owners thousands of dollars. It is reported that a small fortune has been paid for a single plant. Next to possessing one's own collection of orchids is the possession of this, the only work which has ever succeeded in doing justice to these regal flowers.

In the volume, the order of MALAXEÆ is exhibited by three exquisite illustrations. The characteristic feature of the blossoms is their waxy softness. The *Dendrobiums* are notable types, and are not only highly prized as such, but are looked upon as among the most beautiful of the orchidaceæ. Some of them bloom in summer, others in the winter; some can be raised only in green-houses, while others, and they are many, will grow readily in the sitting-room.

THE SECOND ORDER OF ORCHIDS is embellished with two specimens of *Masdevalliæ*, five of the *Cattleyæ*, and three of the *Læliæ*. Some of the Masdevallia present a remarkable appearance, and the flowers closely resemble spiders and other insects. What the rose and the lily are among flowers, the Cattleya is among orchids, — pre-eminently beautiful. The flowers present all shades of rose, rosy-lilac, crimson, carmine, and ruby-purple. Being natives of the temperate regions of South America, they can be grown easily in our climate, and thrive well on billets of wood in pots or baskets. The illustrations of this exceedingly interesting variety are among the finest in the volume, and the longer the eyes linger over them the greater and stronger grows the attraction. Not long ago, one specimen of Cattleya Trianæ, a variety here shown, commanded eleven hundred dollars at a public auction.

THE STORY OF THE ORCHID.

THE story of how the orchids became so much admired is fraught with interest. Travellers in the East had long known of their lovely existence, but they brought home with them only preserved specimens. At length a few living plants were carried to England, were kept alive for a season, and, finally, they perished. Other attempts were made to grow them, and, since 1820, the true plan of their growth and propagation has

been understood. The orchids are now reared in all parts of the world, and, as their rarity decreases, their cost is diminished and their popularity increases.

THE CULTIVATION OF ORCHIDS is easily comprehended, and the method is very simple, as the pages of this volume successfully explain. Heat, ventilation, and moisture are the chief factors. "An orchid house," says the author, "should smell sweet as a flowery meadow does during a sudden burst of sunshine after a summer shower." They require, however, "as much care as a large family of children, and in bestowing such attention on the plants we come to love them."

The variety of PHALÆNOPSIS, of which three illustrations are presented in the volume, derives its name from a fancied resemblance of the central part of the flower to a winged moth or butterfly. To the same order belong the varieties of Oncidium and the Calanthe, each illustrated with one specimen. For winter decoration, the last named is very desirable, their only defect being want of foliage. The *Ærides*, or Air Plants, are set forth in one design, which admirably reveals a combination of rich, evergreen foliage and opposite leaves, with gracefully curved flower stalks and beautiful blossoms. They are natives of the hottest parts of India and other tropical regions, and, attached to trees, imbibe their whole nutriment from the atmosphere. They are all of easy growth, and are not costly.

THE THIRD AND MOST NUMEROUS OF THE ORCHID TRIBES is the Odontoglossum. Of this species three varieties are displayed in the volume. These are properly classed as "cool orchids," and are found chiefly in the mountain ranges. Two specimens of the Lycaste are shown. One of these, the Lycaste Aromatica, is of the same tribe as the Vanilla Aromatica, which furnishes the rich vanilla-bean of commerce. Another beautiful orchid exhibited in the volume is the Vanda Suavis, sometimes called "the sacred mistletoe." The variety of Cymbidium receives one illustration. It is so named on account of the fancied resemblance of the centre of its flower to a canoe or boat.

THE SEVENTH AND LAST TRIBE OF ORCHIDS is the Cypripedium, of which three specimens are shown. Of this tribe, species are quite generally distributed over most Northern States and Canada. The State of New York furnishes six varieties. The word "Cypripedium" is synonymous with "Venus's Slipper." Cypripedium Nivium, or snowy-white Venus's Slipper, exhibits flowers of pure white, dotted minutely in violet. One glance at this exquisite floral gem suggests the devout sentiment of Mrs. Sigourney: —

> "Who hung thy beauty on such slender stalk,
> Thou glorious flower?"

But it is impossible, in this brief sketch, to give more than the merest suggestive outline of the scope, value, and interest attached to this truly regal volume. While looking over these plates, which fairly rival Nature herself, one cannot but recall the study which the late Mr. Charles Darwin gave to orchids; indeed, his volume on "Insect Fertilization" can fittingly be read in connection with them. Our interest in orchids is enhanced by a knowledge that they seem to possess a sort of intelligence, and that they are mostly dependent for the germination of seed and their future growth upon insect agency. Mr. Darwin has explained all this, and these pictures still further elucidate the methods. We behold how it is that the insects, generally bees and the butterflies, are attracted by the perfume, or by their own hunger, to the bosom of flowers where pollen is stored; that, while feeding or visiting in the flowers, a portion of the pollen adheres to the insect, and is carried by it to a needed spot, — some pistillate plant. The poet Cowper thus expresses the scientific truth in regard to orchid reproduction: —

> "These have their sexes; and, when summer shines,
> The bee transports the fertilizing meal
> From flower to flower, and e'en the breathing air
> Wafts the rich prize to its appropriate use."